ROYAL ASTRONOMICAL SOCIETY.

Vol. VI. *February* 14, 1845. No. 13.

Report of the Council of the Society to the Twenty-fifth Annual General Meeting, held this day.

The Report of your Council has generally commenced with congratulation on the progress of astronomy during the past year; but there is a melancholy difference between this annual meeting and all which have preceded it: though astronomy has flourished, the most useful guardian of its interests in this country, and the best friend of our Society, has been removed by death. It will be long before those who conduct our affairs cease to associate the name of Francis Baily with even their smallest details; and every one of them, on the present occasion, remembers that our Annual Reports, up to the present time, were drawn up under his superintendence, and for the most part by his own pen.

As soon as the loss sustained on the 30th of August was known to the Council, a meeting was held (Sept. 20), at which it was determined to call a special general meeting at the conclusion of the ordinary meeting next after the event, not only to enable the Society to make its acknowledgment of Mr. Baily's services public, immediate, and expressive, but also to secure such a biographical record as the historians of astronomy would require at the hands of his surviving colleagues. The composition of a memoir was undertaken by Sir John Herschel, at the request of the Council; and of the manner in which this duty was performed those who had not the good fortune to be present on the 8th of November, when it was read, have ere this formed their opinion from its publication as No. 10 of the current volume of the *Monthly Notices*. The *inane munus* of the eulogist, gratifying as it might have been to the feelings of a friend, was not all that the occasion demanded: careful research, accurate description, well-considered praise, were due here, if ever they could be due any where. To have omitted diligent investigation of his real claims — to have given a negligent account of his great services — to have appropriated to him, by vague expressions of admiration, any part of what was due to another — would have been an insult to his memory; for it would have shewn that his example had been forgotten before his ashes were cold. Your Council, therefore, rejoice that they were able to

command the various qualifications requisite for this important task; and they feel that this meeting will join them in thanking Sir John Herschel, not only for those parts of his memoir which it must have been as pleasant for him to read as for you to hear, but for the elaborate contribution which he has made to the history of astronomy, and the care which he has taken to do justice to others, thus giving at once to the reputation of our lamented President that stability which the eulogist too often leaves to the historian.

In thus acknowledging the recent service of one of our fellows who, by readily undertaking both responsibility and labour, shewed himself a true disciple of the school in which Mr. Baily won his fame, your Council cannot refrain from reminding themselves and you, that, on the continued imitation of the illustrious example which survives the grave, the existence of this Society depends. In the history of a public body, the period is always critical which immediately follows the removal of a member whose zeal and industry were constantly employed in every department: but the first epoch of the kind must excite an anxious feeling; for it is then to be settled whether the association is permanent, or whether it is only the accident of a time. If your Council do not view the present crisis with alarm, it is because they know that the feeling just mentioned prevails throughout the Society, and because they have good reason to hope that, in this as in many other cases, a danger perceived is half avoided.

At the meeting of the Council above-mentioned Mr. Airy was elected President until the present annual meeting in the room of Mr. Baily; and Mr. Christie was elected a vice-president in the room of Mr. Airy.

The Report of the Auditors, which is subjoined, will shew the state of the finances of the Society:

RECEIPTS.

	£.	s.	d.
Balance of last year's account	128	8	0
1 year's dividend on £900 Consols	26	4	4
9 months' ditto on £2143 14s. 10d. New 3½ per Cents	55	3	6
On account of arrears of contributions	111	6	0
66 annual contributions (1844–45)	138	12	0
4 ditto (1845–46)	8	8	0
1 ditto, in part (1846–47)	1	12	0
4 compositions	84	0	0
8 admission fees	16	16	0
5 first year's contributions	9	9	0
Sale of Memoirs	71	2	6
	£651	1	4

EXPENDITURE.

Purchase of £20 7s. 9d. New 3½ per Cents	21	0	0
Magnay and Co. for paper	92	10	6
Harrison and Co. for stationery	12	8	0
J. Basire, for engraving Plates I.–IV. Vol. XV.	54	19	9
Carried forward	£180	18	3

EXPENDITURE (*continued*).

	£.	s.	d.
Brought forward	180	18	3
Moyes and Barclay, for printing Monthly Notices, &c. for Session 1844–45	36	4	0
Cubitt and Co. for repair of rooms on the basement story	43	6	0
C. Rivington, for law expenses	15	8	0
R. Harris, for 1 year's salary as assistant-secretary	83	6	8
R. Harris, for commission on collecting £357 5*s.* 6*d.*	17	17	3
Charges on books, and carriage of parcels	6	17	5
Postage of letters	15	14	8
Porter's and charwoman's work, &c.	10	18	8
Tea, sugar, cakes, &c. for the evening meetings	13	13	0
Coals, candles, &c.	12	18	6
Sundry disbursements by the Treasurer	6	7	0
Taxes: Income tax — 1 9 2			
Land tax — 3 2 6			
Window duty — 5 4 9			
Sewer's rate — 0 12 9			
Church and Rector's rate — 1 14 0	12	3	2
Balance in the hands of the Treasurer (Jan. 22, 1845)	195	8	9
	£651	1	4

The assets and present property of the Society are as follow:

	£.	s.	d.
Balance in the hands of the Treasurer	195	8	9
3 contributions of 6 years' standing — £37 16 0			
3 ——— of 5 ditto — 31 10 0			
5 ——— of 4 ditto — 42 0 0			
2 ——— of 3 ditto — 12 12 0			
14 ——— of 2 ditto — 58 16 0			
24 ——— of 1 ditto — 50 8 0	233	2	0

£900 3 per Cent Consols.
£2143 14*s.* 10*d.* New 3½ per Cent Annuities.
1 Gold Medal unappropriated.
Unsold Memoirs of the Society.
Various astronomical instruments, books, prints, &c.

The progress and present state of the Society, with respect to the number of its Fellows and Associates, may be best seen from the following abstract, continued from the Report of last year, viz.:

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1844	100	122	77	5	304	33	337
Since elected	3	5	...	...	8	4	12
Deceased	−2	−2	−1	...	−5	...	−5
Removals	+1	...	−1	...	...	...	...
February 1845	102	125	75	5	307	37	344

With respect to the instruments belonging to the Society, it may be proper to place on record the present state of them, viz.:

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Beaufoy* clock,
The *Herschelian* 7-feet reflector,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,

are in the apartments of the Society.

The brass quadrant, said to have been *Lacaille's*, is in the apartments of the Royal Society.

The Standard Scale

is under the care of the Astronomer Royal, and, with the consent of the Council, is in actual use for the formation of a new standard measure, under the direction of the Standard Commission.

The remainder of the instruments are lent, during the pleasure of the Society, to the several parties undermentioned, viz.:

The *Fuller* theodolite, to the Lords of the Admiralty.
The other *Beaufoy* clock,
The two invariable pendulums, } to the Royal Society.
The *Lee* circle, to Lord Wrottesley.
The *Wollaston* telescope, to Professor Schumacher.

In the last Annual Report, reference was made to the apartments on the basement story, which formed part of the original grant to the Society, but of which the Government still found it necessary to retain possession. Your Council have the pleasure of stating that these apartments were given up to the Society in the month of May last, and have since undergone complete repair. The advantage of such an accession of room is very great, particularly in that it enables the Society to receive, for safe custody, deposits for which it might be difficult to find a better guardian. Shortly after the apartments were obtained, the Society received (May 24) from the Government the cases containing standard copies of the United States' weights and measures, which had been sent from that country.

The fifteenth volume of the *Memoirs* of the Society is now in the press; and as twenty sheets are printed, it is confidently hoped that it will be ready for publication in a few months.

The gold medal has been this year awarded by your Council to Captain W. H. Smyth, R.N. for the zeal which dictated the construction of the Bedford Observatory, the persevering skill and industry with which his observations on double stars were conducted, and the final catalogue of 850 celestial objects which forms part of his recently published work, entitled *A Cycle of Celestial Objects*. The President will, as usual, at the close of

other proceedings, undertake the description of the grounds on which the Council justify their award and the presentation of the medal.

It will be seen that the portrait of Mr. Baily, by Phillips, which was presented to the Society some years ago, is not in its place. It is now in the possession of the Rev. R. Sheepshanks, who has obtained the loan of it from the Council, for the purpose of having an engraving taken from it at his own cost. We have often been indebted to Mr. Sheepshanks for services which entitle him to the gratitude of every astronomer; but the present obligation is one which this Society will feel to be peculiarly its own.

We have also to notice a present received in November last, from F. Archer, Esq. of a well-executed cast (by himself) from Chantrey's bust of our honorary member, Mrs. Somerville. And Mrs. Somerville herself has presented the Society with an equatoreal which belonged to Smeaton (described in No. 9 of the current volume of *Monthly Notices*), and which was left to her by Smeaton's daughter, Mrs. Dixon. An elaborate and expressive model of the lunar spot *Maurolicus*, and the parts adjacent, executed and presented to the Society by J. Nasmyth, Esq. has attracted much attention.

To her Majesty's Government we have to express our obligations for printing in our *Memoirs*, at the public expense, the late Professor Henderson's right ascensions of principal fixed stars, deduced from observations made at the Cape of Good Hope in 1832 and 1833. It has been a fixed rule with the Council not to print in the *Memoirs* the official transactions of public observatories; and they are happy to say that administrations of all parties, and also the Directors of the East India Company, have always recognised the reasonableness of this rule, the instant the grounds on which it was made were brought before them.

The Council have received from Mr. Baily's executors the manuscript details of the Cavendish experiment.

In the month of March last, Dr. Lee requested that the Society would accept the perpetual advowson of the Vicarage of Stone, near Hartwell. The grant is now enrolled according to the statute. This is the second gift of an advowson from Dr. Lee, to whom the Society is under many other obligations, and who has shewn an incessant interest in its welfare, not only by munificent contributions to its funds, its library, and its collection of instruments, but by active personal services extending over many years.

Among the losses by death, your Council have to regret Captain Basil Hall, Professor Henderson, and Mr. J. Frodsham.

Captain Basil Hall was the second son of the late Sir James Hall, Baronet, of Dunglass, President of the Royal Society of Edinburgh, who is so well known by the experiments which he instituted to corroborate the Huttonian Theory of the Earth.

Basil Hall was born on the last day of the year 1788; and, having very early manifested a predilection for sea life, he entered the Royal Navy in May, 1802, and served his noviciate on the

Halifax Station. On the 10th of June, 1808, he received his first commission as junior lieutenant of the Endymion, in which fine frigate he saw much service on the coast of Spain. In 1812 he joined the Illustrious, of seventy-four guns, bearing the flag of Vice-Admiral Sir Samuel Hood, the naval commander-in-chief in the East Indies; where he so exerted himself, that within two years he was promoted to the rank of commander, and appointed to the Victor, sloop-of-war. This ship was ordered home and paid off, shortly after the peace.

During all these services Basil Hall had manifested an active zeal for attaining a proficiency in nautical astronomy, and the use of its requisite instruments,—a zeal at that time the more meritorious, since it was necessarily pursued among the incessant duties consequent upon a state of actual warfare. To this useful pursuit he added a considerable ardour for geological researches, a taste, which was probably induced by his father's investigations. With such acquirements he was, therefore, strongly recommended to the Admiralty for employment; and he had not been long on half-pay before he was commissioned to the Lyra, a ten-gun brig, expressly fitted to accompany the Alceste frigate on the expedition which carried out Lord Amherst's embassy to China in 1816. His narrative of that memorable voyage, together with his improvements of our knowledge of the Yellow Sea and the coast of Corea, are well known, since his interesting description has passed through several large editions. This expedition was followed by his promotion to post rank in November, 1817.

Having returned from a tour of the continent of Europe, Captain Hall was appointed to the command of the Conway, of twenty-six guns; and on the 10th of August, 1820, he sailed from England for the South American Station. At this time our Society was in its infancy; but Captain Hall, who was always anxious to further the ends of science by making such observations as would be generally available, sent a communication to the Council, expressing his readiness to attend to any instructions on subjects wherein he might promote our views in the South Seas. The reply of the Council will be found embodied in the Report to the first Annual General Meeting, 9th of February, 1821. The Captain's proceedings were published on his return, with a scientific Appendix, by the late Commander Henry Foster, then a midshipman of the Conway.

After paying off this ship Captain Hall engaged himself in various scientific and literary pursuits; for he was of a temperament and inclination which would not admit of idleness. In 1825 he married Margaret, the youngest daughter of Sir John Hunter, Consul-General of Spain; and two years afterwards he made a tour of North America, with his family, the results of which are before the public. From the time of his return to the close of 1841 he was engaged in repeated and extensive journeys in France, Germany, Egypt, and other parts. At length he returned to England, labouring under a melancholy affliction, which, if not

induced, was probably exasperated by his constant mental exertion. After being thus lost to his friends and the world for nearly two lingering years, he expired on the 11th of last September, in the fifty-fifth year of his age. He was buried at Kingston, near Portsea.

Captain Hall was both an accomplished and a very useful officer. If he was sometimes hasty, his warmth of temper was neither ungenerous nor enduring; for he was open to conviction, and ready to make acknowledgment whenever inadvertently in error. His general literary works are well known and admired; but though our business is with those productions relating to science, we may at once pronounce that his talent of describing well what he felt with acuteness, and his accurate power of examining and embodying nautical traits, render his features of sea-life a distinctive picture of the epoch in which he lived and served. His style is natural and easy, and his force and individuality of character are admirable. Under every shadow which stern criticism may muster up, his works must be acknowledged to have done honour to the profession to which he belonged; while the well-directed application of his talents to the service of morality must ever be recognised. Still his most earnest aspirations were for science: "one of the calmest and most unmixed of human pleasures I am acquainted with," said he, "is practical astronomy;" and his reason was, that it inspired unceasing admiration. The writings, which more peculiarly claim our notice are:—

1. Various Hydrographical Remarks on the Indian and China Seas.
2. Memoir on the Navigation of the South American Coast.
3. On the Geology of the Table Mountain.
4. On the Care and Use of Chronometers at Sea.
5. Experiments made with an Invariable Pendulum in South America.
6. A Series of Observations on a Comet seen at Valparaiso in 1821.
7. A Sketch of the Professional and Scientific Objects which might be aimed at in a Voyage of Research.
8. A Method of laying down Ships' Tracks on Sea Charts.
9. A Discussion of the Trade Winds.

At none of its former anniversary meetings has this Society had cause to deplore heavier losses than those it has sustained in the past year. The death of its president, Mr. Baily, was followed, at a short interval, by that of Professor Henderson, of Edinburgh; an astronomer of first-rate merit, and one who, for many years, has been conspicuously distinguished among us by the frequency and importance of his contributions to our publications. His services to the cause for which we are associated have been, indeed, of no ordinary kind; and, although prematurely terminated, have entitled him to a high place among the most deserving of our members. It becomes, therefore, a duty we owe to his memory to recapitulate

in this Report his principal claims to our gratitude, and to place on record a few particulars of his personal history; as well to testify our respect for his eminent merits as to gratify, however imperfectly, the desire which will be felt to know something of the life and character of one whose labours will henceforth form part of the annals of astronomy.

Thomas Henderson was born at Dundee on the 28th of December, 1798. His father was a tradesman in respectable circumstances, who died early in life, leaving to the care of his widow a family consisting of two sons and three daughters. The eldest son, John, was bred to the legal profession; and, after practising for some time as a writer in Dundee, went to Edinburgh, where he studied for the bar, and was rapidly rising to distinction as an advocate, when he died suddenly, at the age of thirty-eight, of aneurism of the heart. Thomas, the other son, and the youngest of the family, was destined also for the profession of the law, and had the advantage of receiving the best education which could be obtained in a town which has long been distinguished in Scotland for the excellence of its public schools. After the usual preliminary instruction, he was sent, at the age of nine, to the grammar-school, where he pursued the usual course of classical study during four years, and was distinguished by his diligence and quickness of apprehension, being generally the dux of his class. In 1811, he proceeded to the Academy, where he continued two years longer. The Dundee Academy was at that time under the very able rectorship of Mr. Duncan, now Professor of Mathematics in the University of St. Andrew's. The course of instruction included elementary mathematics, natural philosophy, and chemistry; and young Henderson passed through the complete course with the same distinction which had marked his progress at the grammar-school. Professor Duncan, in a letter to the writer of this notice, bears the following testimony to the merits of his former pupil. "The two Hendersons," he says, "were the best scholars I had in the whole period of my incumbency. You are aware, I suppose, that John became distinguished at the bar, and was only prevented, by an early death, from rising to great eminence. Thomas, the future astronomer, was remarkable for every thing that was good, — the diligence and success with which he prepared his lessons, the exactness with which he performed the exercises, the propriety and modesty of his demeanour."

At the age of fifteen he was placed in the office of Mr. Small, a writer (or solicitor) in Dundee, with whom his brother had entered into partnership. In this situation he remained six years; and it appears to have been during this period that he began to devote his leisure hours to the study of astronomy, though the particular circumstance, or accident (if, indeed, there were any other cause than the promptings of a naturally active and inquisitive mind), which first gave this direction to his inquiries is not known. During his attendance at the Academy, and even at an earlier date, he had evinced a remarkable predilection for works relating

to geography and chronology; and his taste for these studies was often gratified at the expense of his health, for he was naturally of a weakly constitution, and subject to some disorder of the eyes, which at times rendered him nearly blind. From these subjects to astronomy the transition is easy and natural; and, although he received no aid from the lessons of a master, and had no encouragement from example, yet, in a town which could boast of being the birth-place of Ivory, and in which Dr. Small, the expositor of Kepler, had so long resided, it may be supposed there would prevail, among the better informed classes of the inhabitants, some general sentiment of respect for proficiency in astronomy and mathematics, which might not be without its influence on a mind possessing a peculiar aptitude for such studies. However this may be, the fact deserves to be recorded, as an instance of what may be done under circumstances apparently the most adverse, that it was while employed as an attorney's clerk in a provincial town, that he laid the foundations of that extensive acquaintance with astronomy for which he became afterwards so distinguished.

Having gone through a six years' apprenticeship, Mr. Henderson, at the age of twenty-one, repaired to Edinburgh for the purpose of completing his legal education and obtaining professional employment. He first obtained a situation in the law office of a Writer to the Signet, where his intelligence and abilities were remarked by Mr. (now Sir James) Gibson Craig, who became his steady patron and friend, and by whose recommendation he was appointed secretary, or Advocate's clerk, to the celebrated John Clerk, afterwards one of the judges of the Supreme Court of Scotland, under the title of Lord Eldin. On Lord Eldin's retirement from the bench, he was for some time private secretary to the Earl of Lauderdale; an office which he relinquished for the more profitable appointment of secretary to the Lord Advocate (Jeffrey). In these successive employments, he passed the twelve years from 1819 to 1831; and it may be remarked that, although of a subordinate nature, they were such as would only be intrusted to a person of acknowledged abilities, and one whose character for fidelity, discretion, and general intelligence, was already established. It is probable that they allowed him considerable intervals of leisure, but in no other respect were they favourable for scientific pursuits; and, indeed, it may be regarded as one of the most remarkable features in his history, that, while engaged in the discharge of multifarious and active duties, in a line of life so foreign to astronomy and physical science of any kind, he should not only retain his tastes for the liberal studies he had commenced at the Dundee Academy, but find leisure to make so many new and important acquisitions.

Soon after he became resident in Edinburgh his astronomical acquirements procured him introductions to Professors Leslie and Wallace, Captain Basil Hall, and other distinguished persons, by whom his talents were quickly appreciated, and who afforded him every encouragement to persevere in his scientific pursuits. At that time the small observatory on the Calton Hill, belonging to

the Astronomical Institution of Edinburgh, was placed under the charge of Professor Wallace, who, finding in Mr. Henderson a person to whose hands the instruments could be safely intrusted, allowed him free access to them, and thereby gave him an opportunity of acquiring a practical knowledge of a subject which he had already become familiar with from study and books. The instruments, it is true, were not of first-rate excellence,—a clock and transit of 30 inches focal length, with an altitude and azimuth instrument by Troughton, formed the equipment of the observatory,—but to a young astronomer, who had no other access to astronomical apparatus, such an opportunity was invaluable; and there is little doubt that this circumstance had considerable influence on his future history.

The opportunity of making observations, however, did not in any degree withdraw him from the less inviting parts of the science. From the outset of his career he perceived that, in order to be an astronomer, something more is necessary than mere expertness in the use of instruments. He accordingly continued to direct his main attention to the reduction of observations; and, at an early period, acquired a great knowledge of methods, and great facility in calculating eclipses, occultations, cometary orbits, and, generally, in all the computations and reductions which are subservient to practical astronomy.

Mr. Henderson first brought himself into notice as an astronomer in 1824, by communicating in that year to Dr. Young, then Secretary to the Board of Longitude, a method of computing an observed occultation of a fixed star by the moon, of which that accomplished philosopher thought so highly, that he caused it to be published, under the title of an improvement on his own method, in the *Nautical Almanac* for 1827 and the four following years; accompanied in some of the last of those years by a second method also proposed by Mr. Henderson. These methods were also published in the *London Quarterly Journal of Science;* and he received for them the thanks of the Board of Longitude. About the same time, or shortly after, he began to contribute to the *Quarterly Journal of Science* various useful papers and notices; among which may be mentioned, in particular, elements for computing the eclipses of the sun, and lunar occultations of the planets and satellites for the years 1826, 1827, and 1828; and lists of the principal lunar occultations for the years 1826, 1827, 1828, and 1829. These lists, it is presumed, were the cause of several valuable observations of the phenomena being made, which, but for them, would probably have been neglected.

In 1827 he communicated a paper to the Royal Society of London, "On the Difference of Meridians of the Royal Observatories of London and Paris," which is published in the *Philosophical Transactions* for that year, and which furnishes a remarkable instance of the value of that habit of scrutinising calculation for which he was particularly distinguished. In the copy of the observations officially furnished from the Royal Observatory to

Sir John Herschel, with a view to his operations in 1825 for determining the difference of longitude between Greenwich and Paris by means of fire signals, there was an error of a second in one of the numbers, which had the effect of causing some irregularity in the results of the different days' work; but as the discrepancies were small, they had been ascribed to errors of observation. Mr. Henderson, remarking the irregularity, was led to recalculate the original data, and thereby detected the error; and not content with this, he submitted the entire process to a new calculation. His result differed immaterially from that which had been previously obtained; but the correction of the error, by rendering the single results more consistent, gave a greatly increased confidence to the general conclusion; and, as was said of it by Sir John Herschel himself, "had the effect of raising a result liable to much doubt, from the discordance of the individual days' observations, to the rank of a standard scientific *datum*, and thus conferring on a national operation all the importance it ought to possess."

Mr. Henderson's connexion with this Society began by his undertaking, upon the request of the Council, to compute an ephemeris of the occultations of *Aldebaran* by the moon, in the year 1829, for ten different observatories in Europe. In this undertaking he was associated with Mr. Maclear, and the ephemeris, purporting to be their joint production, was read at the December meeting in 1828, and published in No. 15 of the *Monthly Notices*. His first contribution to the *Memoirs* (published in Vol. IV.) contained observations of transits of the moon, and stars nearly in the same parallel of declination, over the meridian, made at the Calton Hill Observatory in 1828, from which and corresponding observations made at Greenwich he computed the difference of meridians. This paper deserves notice, as shewing that he had already adopted the practice of estimating and allowing for the weights of the results and determining their probable errors, according to the methods in use among the German astronomers, but of which the examples were not, as yet, frequent in this country. The method of determining differences of longitude by means of observations of moon-culminating stars, then recently proposed by Nicolai, had been strongly recommended by Mr. Baily in a paper published in Vol. II. of the *Memoirs*, where all the requisite rules and formulæ were given for the computation. Mr. Henderson entered into these views with his accustomed energy, and not only embraced every opportunity of putting the method in practice by computing corresponding observations, but was at much pains to promote such observations by preparing lists of moon-culminating stars for the use of observers. A list of this kind was prepared by him at the request of the Council for the use of the Arctic expedition under the command of Captain (Sir John) Ross in 1830.

Another subject on which his talents for computation were frequently exercised in furtherance of the views of the Council, was the calculation of the lunar occultations of fixed stars and planets. Observations of these phenomena, interesting both to

practical and physical astronomy, were at that time much encouraged by the Society on account of their use in determining longitudes; and, as such phenomena will seldom be observed unless they have been predicted, it was desirable to ascertain the times of their occurrence by a previous calculation. In this case also Mr. Henderson rendered most efficient aid, by contributing, for several years, monthly lists of the principal lunar occultations computed for the meridian of Greenwich. The promptitude and accuracy with which these calculations were made induced the Council to request him to communicate his methods to the Society; and he accordingly drew up a set of "Practical Rules for the Approximate Prediction of Occultations," which are published in Vol. IV. of the *Memoirs*. These services were duly acknowledged in our *Annual Reports;* and at the anniversary meeting in 1830, the thanks of the Society were voted to him "for the very valuable assistance he had rendered to the cause of astronomy in his various computations presented to the Society."

The amount of Mr. Henderson's contributions to astronomy from 1825 to 1830, consisting of observations, tables, remarks, methods, and calculations of various kinds, published in the *Quarterly Journal of Science*, the *Nautical Almanac*, and the *Notices* and *Memoirs* of this Society, would have done credit to a professed computer; but, in order rightly to appreciate his zeal, it must be remembered that he was all this while occupied with professional duties of a kind which would be found by most persons to be sufficiently engrossing. His disinterestedness was no less remarkable than his scientific ardour; for, though in the receipt of very moderate emoluments, he declined all remuneration for his calculations; nor would this feature of his character be fully appreciated unless it were told at the same time that a considerable part of his income was appropriated by him to the support of his mother and sisters.

Mr. Henderson's official duties, while connected with the Earl of Lauderdale and the Lord Advocate, brought him for some months in each year to London, upon which occasions he became personally acquainted with the principal astronomers of the metropolis, and had an opportunity, particularly at the observatory of Sir James South, which was freely thrown open to him, of seeing and handling instruments of the first class. His various useful contributions to astronomy had already acquired for him a considerable reputation; and the high opinion which had been formed of his talents was increased by observation of the worth and unaffected simplicity of his character, and the range and extraordinary accuracy of his information on all astronomical subjects. Accordingly, a prospect of attaching him to an office by which his services would be secured for the exclusive benefit of astronomy, afforded satisfaction to all those who took an active interest in the progress of our science.

The death of Dr. Robert Blair, in December 1828, having caused a vacancy in the professorship of Practical Astronomy in

the University of Edinburgh, Mr. Henderson's qualifications for that office were represented to the Government (the patrons of the appointment) by Dr. Thomas Young, and energetically urged by some other astronomers, particularly by Captain Basil Hall. From the correspondence which passed with the Secretary of State, it appears that the Government upon that occasion postponed the filling up of the vacancy in order that opportunity might be given to consider upon what footing the office, which had hitherto been a sinecure, could be placed with the greatest prospect of advantage to science. In the summer of 1829, another astronomical appointment became vacant by the lamented death of Dr. Young. This very eminent person had received valuable assistance from Mr. Henderson in the computations required for the *Nautical Almanac*, and had formed the most favourable opinion of his talents. About a fortnight before his death he placed a memorandum in the hands of the late Professor Rigaud of Oxford, to be made use of in case of his decease; and when the anticipated event took place, the memorandum was found to contain a request that it might be stated to the Board of Admiralty that he knew no person more competent to be his successor in the superintendence of the *Almanac* than Mr. Henderson. Professor Rigaud lost no time in making known in the proper quarter the recommendation of his deceased friend, which he also supported with the weight of his own influence; but, in consequence of other contemplated arrangements it was unsuccessful, and the superintendence of the *Nautical Almanac* was, upon that occasion, committed to Mr. Pond, then Astronomer Royal. Mr. Pond was also well aware of the efficiency and value of Mr. Henderson's aid, and immediately preferred a request to him to continue the same computations which he had been accustomed to supply to Dr. Young; making offer at the same time of remuneration, and sufficient employment to occupy a great portion of his time. But, although Mr. Henderson, shortly after, supplied Mr. Pond with some calculations on which he had previously been engaged, this offer appears to have been declined, and for two years longer he continued to follow his professional occupation.

His character as an astronomer, however, was now fully established; and accordingly, on the death of Mr. Fallows, in 1831, he was regarded as one of the persons best qualified to undertake the direction and management of the observatory established by Government, and then recently completed, at the Cape of Good Hope. Through the intervention of Captain Beaufort his qualifications were a second time brought under the notice of the Lords Commissioners of the Admiralty, and on this occasion successfully; but the idea of leaving his country was distasteful to him; and he accepted the office with some reluctance, and only in deference to the advice of his friends. The warrant of his appointment is dated in October 1831, and a few months after he embarked for the colony.

Mr. Henderson arrived at the Cape in April 1832, and forthwith commenced his observations. The principal instruments were

a 10-foot transit by Dollond, and a 6-foot mural circle by Jones; and his only assistant was Lieutenant Meadows, who had been sent out in the previous year. Few examples are upon record of more zealous and successful exertion than that which is furnished by him during his residence of thirteen months at the Cape. The results of his own personal exertions during that short interval comprehend the determination of the latitude and longitude of his station; the positions of stars near the South Pole for determining the polar positions of his instruments; the amount of refraction near the horizon; observations of the moon and stars for determining the moon's horizontal parallax; of *Mars* for determining the parallax of that planet, and thence that of the sun; of eclipses of *Jupiter's* satellites; occultations of fixed stars by the moon; a transit of *Mercury;* places of Encke's and Biela's comets; and, finally, between 5000 and 6000 observations of declination. So large a mass of work would have been sufficiently creditable under the most advantageous circumstances; but when we call to mind that he had to contend with all the difficulties incidental to a new and imperfectly organised establishment, where no assistance was to be obtained from artists, and with a notoriously unmanageable instrument, it will be easily admitted that it would be difficult to overrate the zeal, perseverance, and skill, with which he laboured to discharge the duties which had been intrusted to him. But the merit of accumulating so large and valuable a mass of observations, great as it must be allowed to be, is completely thrown into the shade by comparison with that which is due to the persevering industry with which he laboured in their reduction, and in deducing from them the results we shall presently have occasion to mention.

When Mr. Henderson accepted the appointment to the Cape Observatory, it was no doubt anticipated (probably even by himself) that his residence there would be of some considerable duration. These anticipations were not realised, for in May 1833 he resigned the office, and shortly after returned to Europe. The reasons which induced him to take this step were fully stated by him in his letter of resignation addressed to the Secretary of the Admiralty. After briefly alluding to the exertions necessary to carry their lordships' instructions into effect, he went on to say, that, not only did the state of his health render him unable much longer to support the requisite labour, but that the observatory, considered as a place of residence, laboured under so many disadvantages, and required a mode of life so different from that to which he had been accustomed, that he found it impracticable to remain longer; and being thus unable to perform the duties, he felt it to be incumbent on him instantly to resign the situation. But with that regard for the interests of science, and that kindness of disposition so eminently characteristic of him, he added, that on his return home he would proceed, with the sanction of their lordships, to the task of reducing the observations and of extracting from them the results they were intended to afford; expressed his sense of the efficient aid he had received from his assistant, Lieutenant Meadows; modestly prof-

fered such assistance as his experience might enable him to give to his successor; and concluded by recommending the state of the observatory to their lordships' consideration.

Had his state of health permitted him to continue his observations satisfactorily, there can be little doubt that the inconveniences of which he complained would in due time have been removed, or at least have become supportable; but, he had been made aware before he left England, that his physicians already apprehended the germs of that disease which eventually proved fatal to him, and under the depressing influence of this knowledge, aggravated by separation from all his friends, and his family to whom he was tenderly attached — and by his complete isolation — his spirits gave way, and he became apprehensive that he would be unable to maintain the observatory, from which so much was expected, in a state of the requisite efficiency. Impressed with this idea, he took the resolution to give in his resignation, in order that it might have the contingent benefit of another appointment; and thus an act which, hastily judged, might appear to be an abandonment of his post, was the simple and natural result of a high, it may be an exaggerated, sense of public duty. The sacrifice involved in his resignation was of no small importance to him in a pecuniary point of view; for all he had to fall back upon was a pension of 100*l.* a-year to which he had become entitled upon the retirement of Lord Eldin. But no one was ever less influenced by considerations of personal or pecuniary advantage, and under any circumstances he would have disdained the emoluments of office without the most punctilious discharge of its duties.

On his return to this country in 1833, Mr. Henderson took up his abode in Edinburgh, and being now without official engagements, he began the task of reducing the rich store of observations he had brought with him from the Cape. The first result of this self-imposed labour was the determination of an important astronomical element — the sun's parallax — from a comparison of observations of the declinations of *Mars* near opposition, made at Greenwich, Cambridge, and Altona, with the corresponding observations at the Cape. Previous to his departure for that station he had expressed a wish that a selection should be made of such stars as could conveniently be observed with *Mars* at the opposition in November 1832, with a view to the determination of the parallax, and that a list of them should be circulated among different astronomers in various parts of the world, for the purpose of obtaining corresponding observations. Accordingly, Mr. Sheepshanks having furnished the apparent places of *Mars* during the requisite period, and Mr. Baily having selected the stars to be observed, the council caused the list to be printed and circulated with directions as to the mode in which the observations should be made. In consequence of these preparations four sets of corresponding observations were obtained, from each of which Mr. Henderson deduced a value of the parallax. The mean of the whole gave a parallax of $9''{\cdot}028$; a result which is known from the more certain method of the transits

of *Venus* to be somewhat too large, as was the case also in Lacaille's attempt at the Cape, in 1751, to determine the solar parallax by the same method. The determination, he remarks, is chiefly valuable as shewing the probable accuracy of the method, and the limits within which this important datum in physical astronomy may be determined independently of the rare phenomena of the transits of *Venus*.

Another paper of a more elaborate kind followed soon after, containing an investigation of the anomalies of the 6-foot mural circle in the Cape Observatory. When this instrument was first set up, there were found to be considerable discrepancies in the reading of the different microscopes, a circumstance which occasioned great perplexity to Mr. Fallows; and, although that astronomer ascertained that the mean of the six readings might be depended upon, he did not succeed in arriving at any satisfactory conclusion respecting the cause and the laws of the irregularities. Aware of these anomalies, which, indeed, were confirmed by his first observations, Mr. Henderson, a few weeks after his arrival at the Cape, undertook a laborious examination of the state of the instrument by means of a series of readings of each of the six microscopes at every tenth degree of the limb; and in April and May, 1833, shortly before his departure from the Cape, he repeated the experiment on a more extended scale, by examining the division corresponding to every fifth degree of the circle, and also the divisions immediately before and after it. On the results of this last experiment, which, however, were found to be identical with those of the former one, he grounded the investigation which forms the subject of the paper;—an investigation which exhibits in a very advantageous point of view his sagacity, patience, and laborious accuracy, and is an admirable model of a carefully conducted experimental inquiry. The result was, that, in order to explain the observed anomalies it was necessary to suppose the figure of the instrument to be an oval of small eccentricity, that the pivots of the axis were not exactly circular, and that the whole instrument frequently changed its position upon the pier from the defective bearing of one of the pivots. But the most important conclusion deduced from the investigation,—as it involved no less important a question than the trustworthiness of the *whole* of his Cape observations,—was that the mean of the readings of the six equidistant microscopes was affected only to a very small extent (if affected at all) by these imperfections, and that the probable error of the instrument is not greater than the errors of the best instruments of similar construction hitherto made. From a similar investigation, founded on a less complete examination of the instrument by Mr. Fallows, Mr. Sheepshanks and Mr. Airy, in a paper which is printed in Vol. V. of the *Memoirs*, had previously arrived at a similar conclusion.*

* It may not be without interest to state that, when this instrument was sent back to England some years afterwards, and examined at the Royal Observatory, it was found that, owing probably to some oversight in the construction, the

While thus busily employed with the reduction of his own observations, on the results of which, he was well aware, his reputation as an astronomer would essentially depend, Mr. Henderson's assistance was still, as it had been in the early part of his career, freely extended to others whenever an opportunity occurred of promoting the cause of astronomy. Thus, at the request of Mr. Baily, he undertook the reduction of Captain Foster's observations of the comet of 1830, made at Ascension Island, the results of which, together with an ephemeris for facilitating the calculation of observations of the comet made in the southern hemisphere, are published in Vol. VIII. of the *Memoirs*. Fortunately, however (even though thus turned to account), the interval of leisure was of no long duration; and he was soon called upon for the discharge of more active duties. In 1834 an agreement was concluded between the government and the members of the Astronomical Institution of Edinburgh, whereby the latter gave up to the University the use of their observatory on the Calton Hill, which the former undertook to convert into a public establishment, by furnishing it with suitable instruments, and making provision for an observer and assistant. It was then resolved to fill up the office of Professor of Practical Astronomy, which had remained vacant since 1828, and to combine with it the direction and superintendence of the observatory; and the Secretary of State did this Society the honour to request that a deputation from the Council would confer and advise with him respecting the person whom it might be proper to appoint to the situation. In consequence of this request, a deputation waited upon Lord Melbourne, and, in the strongest terms, recommended Mr. Henderson, whose appointment accordingly followed immediately. The royal commission, nominating him Professor of Practical Astronomy and His Majesty's Astronomer for Scotland, which was dated the 18th of August of that year, required him to take upon himself the care and custody of the instruments within the observatory, and "to apply himself with diligence and zeal to making astronomical observations at the said observatory, for the extension and improvement of astronomy, geography, and navigation, and other branches of science connected therewith."

Mr. Henderson was now placed in a situation suited in every respect to his tastes, habits, and pursuits; and, as he was still young, those who were best acquainted with the extent of his knowledge, his industrious habits, and his facility and accuracy in all practical matters, formed the highest expectations of the value of his future services to astronomy. Nor were their expectations disappointed. The annals of the Edinburgh Observatory, his *Catalogue of Southern Stars*, his investigations of annual parallax, and other deductions from his Cape observations, besides various contributions relative to subjects of a less important, but always of an interesting nature, amply justify the recommendation of our

large steel collar carried by the conical axis was quite loose. It is well, perhaps, the discovery was not made sooner, or the instrument would probably have been condemned, and the observations been lost.

Council; while their very excellence increases our present regrets that a career so auspiciously begun has been so prematurely brought to a close.

As soon as Mr. Henderson had got his observatory into working order, and had established a regular routine of duty, he resumed the reduction of his Cape observations,—an occupation which engrossed the greater part of his leisure time during the remainder of his life, and of which the fruits are a series of papers communicated to the Society and published in our *Memoirs*, all more or less interesting, and some of them of the first order of excellence.

The next result of these reductions, and, indeed, one of the most intrinsically important of the whole, was a Catalogue of the declinations of 172 principal fixed stars, chiefly in the southern hemisphere, which was read to the Society at the April meeting in 1837. Owing to various causes of delay, the reduction of the right ascensions of the same stars was only completed, and the results given to the Society, in the course of the last year. They have, however, already been printed, and will appear in our forthcoming volume. Although the number of stars contained in this Catalogue is not large, it acquires importance and value both on account of the still relatively defective state of our knowledge of the absolute positions of the southern stars, and from the circumstance that it is the first which has been deduced from observations made in the southern hemisphere with instruments equal to those of the best European observatories. Indeed, if we except Mr. Johnson's excellent Catalogue of Stars observed at St. Helena, it must be regarded as the first in which the places of stars not visible in our latitudes have been determined with the precision and certainty now aimed at in astronomy. It was principally with a view to the determination of the positions of the principal southern stars, for the aid of navigation, that the establishment of the Cape Observatory had been urged upon and undertaken by the government, and this catalogue forms one of the most important instalments astronomy has yet received from it.

Although the determination of the absolute places of the stars formed the principal business of the observatory, Mr. Henderson was too zealous an astronomer to omit taking advantage of the circumstances in which he was placed to investigate various important points which can only be determined by a comparison of observations made at places remote from each other, or which acquire a special interest from the position of the observer. A point of this latter kind is the amount of refraction in the southern hemisphere. In an interesting paper on this subject, printed in Vol. X. of the *Memoirs*, he has given the results of a series of observations made at the Cape, of stars having a greater zenith distance than 85°, both north and south, and compared the refractions thence deduced with the tables of Bessel and Ivory. As tending to throw light on the important subject of horizontal refractions, these results are valuable with reference to general physics as well as to practical astronomy.

Another important determination, also prompted by the locality, was that of the moon's horizontal parallax. It is well known that the determination of this element was one of the principal objects of Lacaille's voyage to the Cape; his purpose being to obtain observations of the moon's declination corresponding to others made at different European observatories. A similar investigation was proposed for Mr. Henderson, or rather several stars had been marked in the *Berlin Ephemeris* and *Nautical Almanac* as favourably situated for having their declinations observed along with the moon's in both hemispheres, by which means the moon's apparent declinations are obtained free from the effects of errors in the assumed declinations of the stars. But the number of corresponding observations of this kind which could be made, being found to be too small to permit the element to be determined from them with sufficient accuracy, Mr. Henderson had recourse, whenever there was a deficiency of moon-culminating stars, to such of the principal stars as were observed, and could be used for comparison. The investigation, like all others which he undertook, is conducted in the most careful manner; and the result, although, in consequence of the mode of proceeding adopted, it is dependent on the accuracy of the determination of the relative declinations of the principal stars, is probably the best determination of the constant we are in possession of.

It would almost seem as if, in these investigations, Mr. Henderson had it in view to repeat the labours of Lacaille in his memorable residence at the Cape about the middle of the last century. In another and more important feature he may be considered as an imitator of that great astronomer. Lacaille had remarked that, in the *then* advanced state of astronomy no one could any longer be believed on his mere word; and that, in order to employ with confidence an observed position, it was necessary to have all the details of the observation and all the elements of reduction. No astronomer was ever more careful of the observance of this important maxim than Mr. Henderson. From the reading of the circle to the final result of the investigation, every thing necessary for the complete understanding of the process or verification of the work is carefully set forth and explained; and, accordingly, all his investigations and results are characterised by an air of truthfulness which it would be in vain to look for where a different practice is followed.

But of all the results which he deduced from this persevering examination of his Cape observations, the one which will be considered as the most interesting is the annual parallax of the double star α *Centauri*, amounting to about a second of space. This binary system was recognised to be double about a century ago; and, on comparing the observations of Lacaille with those of the present time, it is found to have an annual proper motion of about $3''{\cdot}6$. Being situated within about 30° of the South Pole, it is always above the horizon at the Cape, and, consequently, favourably placed for being accurately observed at all times. The

intrinsic brightness of the two component stars is also remarkable; and from this, and their large proper motion — circumstances indicative of proximity to our system — Mr. Henderson was led to suspect they might have a sensible parallax. He was not, however, aware of their large proper motion till he was about to leave the Cape; and the observations from which the result was first deduced, were accordingly not made with especial reference to the question of parallax, but for the purpose of determining their mean positions. The first indications of parallax were detected upon a comparison of their declinations with those of such of the standard stars as were observed on the same day throughout the year; but he deferred the announcement of the discovery until he had completed the reduction of the right ascensions, and obtained, by this means, a further test of the accuracy of his conclusion. A similar investigation of these latter observations confirmed the previous deduction; and, in a paper read to the Society at the January meeting of 1839, he announced a parallax of the double star amounting to about a second of space. With his habitual caution and accuracy, he applied every means of testing the result the observations afforded, deducing the parallax separately from the observations of right ascension, from the direct observations of declination, and from the reflected observations of declination, and this in respect of each of the two stars; and though the resulting parallax differed somewhat in the different cases, the general agreement was satisfactory, and the amount much too large to be ascribable to probable errors of observation. But notwithstanding the corroboration which the results of these different modes of deduction afforded each other, if the question of the parallax of this binary star had been allowed to rest in the state in which it was placed in Mr. Henderson's first paper, astronomers would probably have agreed in thinking his investigation only went the length of establishing a strong probability in favour of its existence. Mr. Main, after an elaborate comparison of the result with the individual observations from which it was deduced, observes, "For the present it must be considered that the star well deserves a rigorous examination by all the methods which the author himself has so well pointed out; and that, in the event of a parallax at all comparable with that assigned by Mr. Henderson being found, he will deserve the merit of its discovery, and the warmest thanks of astronomers, as an extender of the knowledge we possess of our connexion with the sidereal system."—*Memoirs*, vol. xii. p. 36. The result, however, was far too curious to be allowed long to remain without an attempt being made to confirm it. No sooner was Mr. Henderson's paper communicated to Mr. Maclear, than that energetic astronomer undertook a series of observations of the double altitudes of the two stars with the mural circle, with an express view to the question. They extend over seventeen months, from March 26, 1839, to August 12, 1840; and, as the mural circle at the Cape was changed shortly after their commencement, they have the further advantage of having been made, for the

greater part, with a different instrument. These observations being transmitted to Mr. Henderson, he immediately undertook to reduce them; and, in an elaborate paper inserted in Vol. XII. of the *Memoirs*, he deduced the parallax for each of the two stars both from the direct and reflected observations. The results entirely confirmed his former deductions, but, as was to be expected from the greater number of observations, they were more consistent. The mean gave, as before, a parallax of about 1″; whence it is inferred that this system, the nearest, perhaps, of the stellar bodies, is separated from us by an interval exceeding 200,000 times the distance of the sun from the earth.

Looking to the history of this interesting subject — to the consistent results given by the Dublin circle, which have been disproved by other instruments — and considering that the present determination has as yet been only partially confirmed by the observations of right ascension, the cautious astronomer will, perhaps, be inclined to maintain some reserve until the star shall have been examined with an instrument affording the means of exact micrometrical measurement, or, at least, until a longer series of meridian observations shall have been made; for, as has been remarked by Sir John Herschel, "It is only on a very long series of observations of absolute places, affected, as they are, by instrumental error and uncertainty of refraction, that any conclusion of this kind can rest with security." But whatever the ultimate decision of astronomers may be with respect to the parallax in question, there will be but one opinion as to the merit of Mr. Henderson's investigations, and the interest which attaches to the subject: and, in the meantime, it will be remembered that this is the first determination of the parallax of a star which has been confirmed by a different observer using a different instrument; and that if future observations shall continue to give similar results, which now seems a reasonable anticipation, to Mr. Henderson will indisputably belong the enviable distinction of having been the first who succeeded in an inquiry so often, but fruitlessly, attempted by astronomers, namely, the discovery of a fixed star whose distance from our system is capable of measurement and expression. For these researches he was proposed to the Council at the meeting in November last, as deserving the Society's gold medal for the present year, but his untimely death prevented the question from being entertained.

Another attempt made by him to determine the annual parallax was less successful. *Sirius*, the brightest star in the heavens, might be supposed to be one of the least remote; and some astronomers — Cassini, Lacaille, and Piazzi — had assigned it a parallax of several seconds. The Cape observations being well adapted for the investigation of the question, Mr. Henderson undertook the examination of those made by himself, and also a series by Mr. Maclear, in order to ascertain if they indicated any sensible parallax; but, in this case, the result amounted only to about a quarter of a second, — a quantity not exceeding, perhaps, the probable error of the determination.

Mr. Henderson's labours on the subject of parallax did not terminate even here. In a letter to Mr. Main, which was read at the December meeting of 1842, he gave the results of an investigation of the parallaxes, as they appear from his Cape observations, of twenty stars which had been observed sufficiently often to reduce the errors of observation within reasonable limits. They comprehend the greater number of the stars situated in the same region of the heavens as *α Centauri*, which have been indicated by Sir John Herschel as deserving of investigation for parallax, and which, on that account, are at present objects of particular attention at the Cape Observatory. In a few instances considerable parallaxes appear; in the greater number of cases the results are so small as to afford little hope of a measurable parallax being found, and in some they are negative. The mean of the twenty parallaxes is + 0″·29, a result which, on the whole, may be considered as affording encouragement to continue the research.

It is matter of much regret that the reduction of the entire series of Mr. Henderson's Cape observations—the rich store from which the above interesting results have been extracted—has not been completed by him; and that the observations must consequently be deprived of the advantage of his final revision. From the examination of his papers it appears that the number of positions determined both with the mural circle and transit instrument, from April 10, 1832, to May 24, 1833, is between 5000 and 6000. The transit observations (made chiefly by Lieut. Meadows) are found to be carefully written out, with the column headed "correction of instrument" filled up for the whole period; and that headed "correction of clock" from the commencement to October 31, 1832. The circle observations, which were all made by himself, are in a similar state of forwardness; and it may be inferred from the appearance of the papers that if he had lived a few months longer, and the work had proceeded at the ordinary rate, the whole would have been ready for the press.

A statement of the results deduced by Mr. Henderson from his Cape observations could not be properly concluded without an expression of admiration for that disinterested zeal which led him to undertake and execute so great an amount of extra-official labour. The observations, it will be remembered, were made at a public establishment, and their reduction was matter of public concern and importance; and after his resignation of the appointment, the public had no claim on his services more than on those of any other individual. But, as already remarked, considerations of this kind never, in any degree, influenced his conduct; and, during ten long years, he gratuitously devoted to this purpose all the time he could spare from his official duties. In the same circumstances almost any other person would have claimed, and undoubtedly have obtained, both assistance and remuneration.

In addition to the results now mentioned, he rendered still another important service to the astronomy of the southern heavens, in superintending the reduction of the stars observed at the Cape

by Lacaille. This work, which he undertook at the instance of Mr. Baily for the British Association, was announced as completed in our Annual Report for 1843; but it has not yet been published.

Mr. Henderson's labours in the Edinburgh Observatory are well known to astronomers from the five volumes of observations which have been published for 1834-1839. A sixth volume is understood to be left nearly ready for publication; and the observations for the remaining years will, no doubt, still be rendered available to science. The published volumes are prefaced by an Introduction, containing a minute and most lucid description of the instruments and methods used in the observations and reductions, with every detail and explanation which can contribute to give authenticity and value to the work. His first year's observations having been referred to this Society by the Home Secretary, a committee of the Council reported them to be of first-rate excellence, and recommended their publication as matter of scientific importance. This report has been ratified by all astronomers; and, so far as they have yet been published, the Edinburgh observations not only do credit to the astronomer and his assistant, Mr. Wallace, but have conferred on the Observatory a high reputation among the similar institutions of Europe.

Although the periodical publication of the Edinburgh observations rendered it, in a great measure, unnecessary for him to have recourse to other channels of publicity, he continued, from time to time, to communicate to this Society various observations of phenomena, either of an occasional nature or having an immediate interest, and notices likely to be useful to practical astronomers. Among these may be mentioned observations of the planets near their oppositions and inferior conjunctions, of moon-culminating stars, of the annular eclipse of the sun on May 15, 1836; and, more especially, elements of cometary orbits. Indeed, if he had no other claim on our regard, his care in disseminating the earliest information respecting the orbits of newly discovered comets would alone have entitled him to the applause due to a useful labourer in the cause of astronomy. Various observations and notices of the kind now referred to were also communicated by him to Professor Schumacher, and published in the *Astronomische Nachrichten*, whereby they obtained immediate circulation over the Continent.

His attention at Edinburgh was chiefly directed to planetary observations, and the formation of an extensive catalogue of zodiacal stars. He had proceeded far in the latter work; and in one of his last letters, written to an intimate friend, he spoke of being engaged in fixing the positions of some of those stars in Argelander's recent catalogue, which, though visible to the naked eye, had escaped the notice of all former astronomers.

In recounting Mr. Henderson's labours in the Edinburgh Observatory, we should fail to do justice to his zeal if we omitted all allusion to other avocations which occasionally made large demands on his time. His office of professor, though he gave no lectures in his own

department, entailed on him various duties. During one whole session (1835-1836) he delivered the mathematical lectures for Professor Wallace, then incapacitated by illness; and in the last year he undertook, for some time, a similar duty for Professor Forbes, in the class of Natural Philosophy. In short, he was one whose general talents and habits of business, coupled with extreme benevolence and great good sense, rendered him a most useful coadjutor; and, accordingly, the largest share of any public business, with which he happened to be connected, was sure to fall into his hands.

Having none of the accessory advantages of birth, fortune, or early introduction, Mr. Henderson had to rely on his own energy and talents alone in conquering his way to fame; and he was only beginning to enjoy his well-earned reputation, both in his own country and abroad. He was admitted a Fellow of this Society in 1832, and of the Royal Society in 1840, and he had been a member of the Royal Society of Edinburgh since 1834. It does not appear that he was a member of any foreign society, but he was in frequent correspondence with Schumacher, Bessel, Encke, and other distinguished astronomers on the continent, by whom his talents and opinion on astronomical subjects were held in high estimation.

In 1836 he married Miss Adie, eldest daughter of the well-known optician and ingenious inventor of the sympiesometer. The death of this lady in 1842, a few weeks after the birth of their only child, produced an effect on his sensitive temperament from which he never completely recovered. In the summer of that year he was gratified by an event which afforded him at the time the liveliest pleasure, and ever after formed a bright spot in his memory. This was the visit to Edinburgh of Professor Bessel, whom he had always been accustomed to regard as his master in science; and for whose character and writings he entertained an unbounded admiration. In company with the great astronomer, and his countryman and colleague, the celebrated mathematician Jacobi, he made a short excursion to the Highlands; and his friends well remember the delight with which he used to recount the incidents of that journey, and relate anecdotes of his illustrious companions.

Although his constitution was never robust, and he was occasionally subject to low spirits, during the influence of which he would express misgivings as to his hold on life, his health did not undergo any visible change till the autumn of 1844, when he was suddenly seized with an illness of so alarming a kind, that, happening at the time to be on a visit to a friend, some days elapsed before he could be removed to his own house. From this attack he partially recovered, and hopes were entertained that he would soon be enabled to resume his usual duties; but a relapse having occurred, he expired suddenly on the 23d of November, a few weeks before he would have completed his forty-sixth year. The disease was then ascertained to be hypertrophy of the heart; and there

can be little doubt that, in the state of health induced by this organic disorder, the fatigue of the nightly observations, and of climbing the steep hill on the summit of which the observatory is built, had been extremely prejudicial to him, and contributed to accelerate its fatal termination.

The character of Mr. Henderson as an astronomer stands high, and his name will go down to posterity as an accurate observer, an industrious computer, a skilful manipulator, and an improver of methods in that department to which he devoted himself. Endowed by nature with perceptive powers of great acuteness, and accustomed by his early professional training to examine and sift the evidence of every fact or statement presented to his mind, and to keep it before him until he had obtained a clear conception of it in all its bearings, every acquisition he made was perfect; and all his knowledge was stored up in a memory of unusually retentive powers, in so orderly a manner as to be always available at the moment it was wanted. A sharp eye, and habits of order, regularity, and attention, enabled him to become an excellent observer; but the services for which he will be remembered consist not so much in numerous and accurate observations, as in the use which he made of them and the manner in which he worked out their results. At the outset of his career he was led (probably by the commendation of them in our *Memoirs*) to study attentively the methods of the German astronomers, particularly those of Bessel and Struve, upon whose model he formed his practice, and from which he never departed. All his memoirs and investigations are characterised by the excellences of those illustrious masters. Every observation is scrupulously discussed, and its results drawn out in the most concise and serviceable form. His processes are fully explained; his formulæ of reduction carefully chosen; no labour is evaded; and no circumstance which can affect the accuracy of the final result is passed unnoticed. Nor is the manner in which his results are set forth and communicated inferior to the skill displayed in deducing them. His descriptions of instruments, methods, and details of practice, are stamped by a simplicity, neatness, and precision, which shew at once the correctness of his taste and his mastery over his subject. His introductions to the Edinburgh observations may be cited as admirable specimens of astronomical writing. Nothing, indeed, is more remarkable in all his compositions than good taste, and the entire absence of every trace of exaggeration of his own merits or affectation of singularity. Discerning clearly his object, he pursues it in a direct undeviating course; never stepping aside for the sake of display, yet skilfully availing himself of every means of reaching it, which science had placed at his disposal. To represent him as profoundly skilled in the higher departments of physical astronomy would be to make a pretension, from which the modesty of his nature would have recoiled; but he had a sufficiently accurate knowledge of the analytical processes by which the phenomena of the universe are deduced from, or connected with, the theory of gravitation, to appreciate

correctly their bearings on the practical branches, to which he directed his attention. To a very considerable knowledge of mathematics he added great powers of calculation—powers which he never abused; for though less liable than most men to make mistakes, he, in no case, allowed himself to dispense with the most scrupulous revision of his work. One of his most distinguishing qualities was sound judgment. He never attempted any thing to which his powers were not fully equal; and, as a consequence of this, whatever he did he did well.

Few men have been more conversant with the modern history of astronomy, especially that branch of it with which he was more immediately connected. It may be said, without any exaggeration, that he knew, and could name the author of every invention or contrivance, whether mathematical or mechanical, bearing on his professional duties.

In his private character, and the relations of domestic life, Mr. Henderson was distinguished by great warmth of affection and amiability of disposition. Naturally modest and retiring he shrunk from the most distant contact with obtrusiveness and ostentation; but he knew well enough his position, and was by no means deficient in spirit to defend it. His disposition was cheerful and social; and when released from official duties he took great pleasure in the society of his friends, to whom he was endeared by the worth of his character, the unaffected simplicity of his manners, his kind-hearted benevolence, and enthusiastic admiration of whatever is noble and excellent. His reputation for astronomical knowledge, and his readiness to assist in its promotion, involved him in an extensive correspondence; but, however occupied he might be, when reference was made to him on any point connected with his professional pursuits, he was always to be depended upon for a prompt answer, either containing (as was most frequently the case) a full exposition of the matter in hand, or a frank acknowledgment that he had no information to give. He was disinterested and generous to a degree hardly consistent with his circumstances. Notwithstanding his slender appointments he had already collected an extensive and valuable astronomical library; but the proceeds of its sale were the principal part of the heritage he left for his orphan daughter.

The loss of so excellent a member, at an age when his knowledge and faculties had only attained to maturity, and when past triumphs justified the brightest anticipations for the future, cannot be regarded by the Society with feelings of ordinary regret. Let us hope there will never be wanting among us examples of similar and equally successful devotion.

The following is a list of Mr. Henderson's Astronomical Papers.

I. In the *Memoirs of the Royal Astronomical Society*:—

Observed Transits of the Moon and Stars nearly in the same Parallel of Declination over the Meridian. Vol. IV. p. 189.

Note on the difference of Meridians between the Observatories of Greenwich and Edinburgh. Vol. IV. p. 191.
Practical Rules for the Approximate Prediction of Occultations. Vol. IV. p. 587.
On the Latitude and Longitude of the Observatory at the Cape of Good Hope. Vol. VI. p. 125.
Positions of several Stars near the South Pole, deduced from Observations made at the Observatory at the Cape of Good Hope. Vol. VI. p. 133.
Observations of the Periodic Comet of 6·7 years, made at the Observatory, Cape of Good Hope, between Nov. 18, 1832, and January 3, 1833. Vol. VI. p. 159.
Observations of the Moon and Stars made with the Mural Circle at the Observatory, Cape of Good Hope, for the determination of the Moon's Parallax. Vol. VI. p. 205.
Observations of *Mars* and Stars made with the Mural Circle at the Observatory, Cape of Good Hope, for the determination of the Parallax of *Mars*. Vol. VI. p. 207.
Letter to Professor Airy, on the Sun's Parallax, as deduced from various Observations made at Greenwich, Cambridge, and the Cape of Good Hope. Vol. VIII. p. 95.
Supplement to a Paper, entitled "On the Latitude and Longitude of the Observatory at the Cape of Good Hope." Vol. VIII. p. 137.
On the Mural Circle of the Observatory at the Cape of Good Hope. Vol. VIII. p. 141.
Observations of the Comet of 1830, made at Ascension Island, by the late Captain Foster. Reduced by Mr. Henderson. Vol. VIII. p. 191.
Observations of *Vesta* at the Opposition in 1834, made at Edinburgh. Vol. VIII. p. 232.
Observations of *Jupiter* at the Opposition in 1834, made at Edinburgh. Vol. VIII. p. 234.
Observations of *Venus* at the Inferior Conjunction, in December, 1834, made at Edinburgh. Vol. VIII. p. 236.
Observations of *Mars* at the Opposition in January, 1835, made at Edinburgh. Vol. VIII. p. 238.
Places of the Comet of Biela, deduced from Observations at Slough and the Cape of Good Hope. Vol. VIII. p. 240.
Places of Encke's Comet, from Observations made at the Cape of Good Hope. Vol. VIII. p. 243.
Notes on Mossotti's Observations of the Comet of Encke. Vol. VIII. p. 250.
Notes on Mr. Dunlop's Observations of Two Comets in 1833 and 1834. Vol. VIII. 264.
Results of the Lunar Observations made at Edinburgh in the years 1834 and 1835. Vol. IX. p. 272.
On the Declinations of the Principal Fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope, in the years 1832 and 1833. Vol. X. p. 49.

Refractions of Stars near the Horizon, observed at the Cape of Good Hope. Vol. X. p. 271.

The Constant Quantity of the Moon's Equatorial Horizontal Parallax, deduced from Observations made at Greenwich, Cambridge, and the Cape of Good Hope, in 1832 and 1833. Vol. X. p. 283.

On the Parallax of *α Centauri*. Vol. XI. p. 61.

On the Parallax of *Sirius*. Vol. XI. p. 239.

The Parallax of *α Centauri*, deduced from Mr. Maclear's Observations at the Cape of Good Hope, in the years 1839 and 1840. Vol. XII. p. 329.

The Right Ascensions of the Principal Fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope, in the years 1832 and 1833. Vol. XV. p. 129.

II. In the *Monthly Notices* of the Royal Astronomical Society :—

Occultations of *Aldebaran* by the Moon, in the year 1829, computed for ten different Observatories in Europe, by T. Henderson, Esq. and T. Maclear, Esq. Vol. I. p. 89.

A List of the Occultations of *Aldebaran* by the Moon, in the year 1830, computed for ten different Observatories in Europe, by T. Henderson, Esq. and T. Maclear, Esq. Vol. I. p. 133.

Various Observations made at the Royal Observatory, Edinburgh. Vol. III. p. 129.

Opposition of *Uranus*, August 1835, observed at Edinburgh. Vol. III. p. 143.

Oppositions of *Jupiter* in January 1836, of *Juno* in January 1836, and *Vesta* in March 1836, observed at Edinburgh. Vol. III. p. 200.

On the Annular Eclipse of the Sun, on May 15, 1836. Vol. IV. p. 165.

Apparent Positions of Galle's first Comet. Vol. V. p. 9.

Elements of Galle's first Comet. Vol. V. p. 16.

On the Parallaxes of certain Southern Stars. Vol. V. p. 223.

Elements of the Comet of 1668. Vol. V. p. 266.

Elements and Ephemeris of the Great Comet of 1843. Vol. V. p. 266.

Letter to the Secretary on the Great Comet of 1843. Vol. V. p. 267.

Approximate Elements of the Comet of Faye. Vol. VI. p. 15.

On the Orbit of the Comet of Faye. Vol. VI. p. 18.

Elements and Ephemeris of the Comet of Faye. Vol. VI. p. 57.

III. In the *Philosophical Transactions of the Royal Society of London* :—

On the Difference of Meridians of the Royal Observatories of Greenwich and Paris. Vol. for 1827, p. 286.

Observations of the Comet of Encke made in 1832. Vol. for 1833, p. 549.

IV. In the *Philosophical Magazine*:—

On Mr. Burns' Method of finding the Latitude by Double Altitudes Vol. LXVI. p. 283.

Some Remarks on Captain Sabine's Pendulum Experiments. Vol. II. (New Series), p. 126.

V. In the *London Quarterly Journal of Science*:—

Rules for Computing an observed Occultation of a Fixed Star by the Moon. No. XXXVI. p. 343. Also in New Series, No. II. p. 434. Annexed also to the *Nautical Almanacs* for 1827–1831.

Remarks on the Determination of the Longitude from Observations of the Moon's Right Ascension. No. XXXVII. p. 109.

Discordance of the Lunar Observations made at Greenwich and Paris. No. XXXVII. p. 116.

Corrections of the Catalogue of Zodiacal Stars. No. XXXVIII. p. 239.

A Method of Computing the Sun's Horizontal Parallax from Observations of the Transits of *Venus*. No. XXXIX. p. 94.

Remarks on the Discordances observed between the Lunar Observations at Greenwich and Paris. No. XXXIX. p. 96.

Remarks on M. Mendoza Rios' Method of computing the True from the Apparent Lunar Distances. No. XL. p. 315.

In the *Quarterly Journal*, New Series:—

Remarks on the Solar Tables. No. II. p. 438.

Answer to some Objections stated against the Method for Computing an Observed Occultation. No. VIII. p. 411.

VI. In *Schumacher's Astronomische Nachrichten*:—

Note on the Occultation of Mercury by the Moon on Aug. 9, 1831. No. 190, col. 437.

Astronomical Observations made at Edinburgh in 1831. No. 242, col. 25.

Note on Mossotti's Observations of Encke's Comet. No. 243, col. 39.

Account of Observations made at the Cape of Good Hope in 1832 and 1833. No. 257, col. 293.

On the Longitude of the Cape Observatory, and the Sun's Mean Equatoreal Horizontal Parallax. No. 262, col. 403.

Elements of Two Comets observed at Paramatta in 1833 and 1834. No. 271, col. 117.

Mean Declinations of 172 Principal Fixed Stars, deduced from Observations made at the Cape of Good Hope. No. 318, col. 81.

Refractions of Stars near the Horizon, observed at the Cape of Good Hope. No. 319, col. 103.

On the Moon's Equatoreal Horizontal Parallax. No. 338, col. 25.

On the Comet of 1668. No. 476, col. 333.
Elliptic Elements of Faye's Comet. No. 495, col. 235.

Computations of the principal Lunar Occultations of the Fixed Stars, during the years 1826, 1827, 1828, and 1829, made for the Royal Observatory at Greenwich.

Elements for Computing the Eclipses of the Sun, and Lunar Occultations of the Planets and their Satellites, for the years 1826, 1827, and 1828. In various Numbers of the *Quarterly Journal.*

Computations of the principal Lunar Occultations of the Fixed Stars and Planets, for the years 1830, 1831, and 1832. In *Monthly Notices of the Royal Astronomical Society*, and in the *Nautical Almanac.*

Ephemeris of the Comet of 6·7 years, in *Supplement to Nautical Almanac for* 1832.

On γ *Virginis.* In Smyth's *Cycle of Celestial Objects*, vol. i. p. 483.

Mr. John Frodsham was originally placed under an eminent workman, who was in the employment of Messrs. Troughton and Simms, to learn the manufacture of astronomical and mathematical instruments. From this employment he was withdrawn by his father, of the firm-of Parkinson and Frodsham, chronometer-makers, a vacancy having, by an unhappy accident, suddenly occurred in his establishment, which could only be filled up by a person of acknowledged ability, and in whom entire confidence could be reposed. Mr. Frodsham devoted himself immediately with great energy and success to the business of chronometer-making, and shewed a singular dexterity in some of the most delicate adjustments, particularly in isochronizing the vibrations of the balance for unequal arcs.

He pursued the business of his profession with great zeal, and, having the advantage of a previous liberal education, his friends looked forward to his future efforts with considerable confidence. His death, which occurred in July last, was occasioned by a fall from his gig, from which he was thrown with considerable violence on his return from a drive, in the neighbourhood of London. The members of this Society will, doubtless, sympathise with his father, Mr. W. J. Frodsham, under this severe bereavement. He has to grieve not only over the sudden removal of a beloved son, but of a friend and a partner, who shared with him the most serious and important of his business anxieties, and on whose advice and assistance he might with confidence have calculated during the remaining years of his life.

The Royal Observatory must occupy a very prominent place in this year's Report.

The reduction of the Greenwich planetary observations from

1750 to 1830 was suggested by the British Association at the Cambridge meeting. On the motion of the Board of Visitors of the Royal Observatory, Her Majesty's government undertook to defray the expense of printing, and committed the work to the charge of the Astronomer Royal. All is now done and printed, in 671 large quarto pages, except the introduction. There are five sections: I. contains the investigation of clock errors and rates, and computation of mean time, all by stars; II. Investigation (by stars) of index errors of quadrants and circles, and zenith points of circles (the *Tabulæ Regiomontanæ* are the basis of these two sections); III. Geocentric places of the planets inferred from the original observations, and corrected by the elements obtained in I. and II.; IV. Computation of the tabular geocentric places of the planets, each from the best existing theory applying to that planet (the four small planets excepted); V. A comparative view of the observed and tabular geocentric places, and an exhibition of the equations which this gives for the heliocentric errors of each planet.

The reduction of the Greenwich lunar observations from 1750 to 1830 was also suggested by the British Association, and has been carried on, under the superintendence of the Astronomer Royal, at the expense of the government. The reductions being now very nearly completed, the Board of Visitors has recommended to the government to print them with considerable detail, and with actual correction of the elements of the tables. This last is rendered practicable by the deduced results having been uniformly compared with those of Plana's lunar theory (with some emendations). It is understood that an adequate sum is to be inserted in next year's estimates.

It will be perceived that the Royal Observatory is making up its ledger; and future astronomers, who will nearly as soon publish unmade as unreduced observations, will be surprised at the uniform credit which it has maintained during the long period in which it has never investigated the state of its own accounts. The truth is, that it has always led the world; and it is not fair to demand of the highest why it is not yet more high. We may now confidently expect new lunar tables, and considerable emendations of the planetary ones. The astronomical world will not fail to bear in mind what it owes to the present Astronomer Royal, who, when at the head of the Cambridge Observatory, first presented a complete volume of reduced observations as part of the regular business of the institution. If, as may reasonably be assumed, the impulse given to astronomy in England by the young exertions of this Society was one of the causes of the foundation of an observatory at Cambridge, we form no trivial wish when we hope that the consequences of the future may equal in importance those of the past.

It is probably known to most of the Fellows that the government, on the representation of the Astronomer Royal to his Board of Visitors, has sanctioned the erection of an altitude and azimuth instrument for extra-meridional observations of the moon. For

more than a century all fundamental observations of stars and planets have been made in the meridian; and, if sufficient frequency of observation could be insured, there is no reason to suppose that any other species of observation could be required. In the case of the moon, however, there is a necessary loss of the meridian observation during a part of the month, and occasional occurrence of clouds at the time of otherwise visible transit; to which it must be added, that theoretical knowledge of our satellite is so advanced, as to make it difficult to carry it further by such sets of observations as can be procured with meridional instruments. The Astronomer Royal has therefore determined to commence the task of following the moon through her daily course to an extent which will supply, or more than supply, the failure of meridian opportunities; and your Council feels a sanguine presentiment that this abandonment of the meridian will be an epoch in the history of astronomy. The altitude and azimuth instrument is constructed on the same general principles as the ordnance zenith sector described by Mr. Airy at the meeting of May 13, 1842. It consists of very few parts, and these cast, and therefore rather massive; and so important has it been considered to unite the small parts, that the microscopes are cast in the same piece with the rest, and are bored afterwards. The instrument turns on pivots above and below. The revolving azimuthal frame consists only of four casts—namely, the lower end, with a pivot and four microscopes; the two sides, of which one has four microscopes; and the top, with its pivot. The moving vertical circle consists of two parts only; one having one pivot, the graduated circle, and the two ends of the telescope, the other having the other pivot. The extreme firmness which is required in the construction of a *theodolite* (as it may very properly be called), which shall give results comparable to those of the *fixed instruments*, is, of course, accompanied by considerable loss of manual adjustment, and consequent increase of arithmetical reduction. Those who have any idea of the very serious labour involved in the contemplated class of observations, as compared with that required in meridional work, will feel that the present Astronomer Royal has dictated to his successors the motto by which Ptolemy described Hipparchus, φιλοπονος και φιλαληθης; and they will also feel that he has adopted it for his own.

Your Council cannot but feel it to be a matter of congratulation that the principal public observers of Great Britain have, to no small extent, begun to bear in mind that different observatories, situated at no great distance from each other, should aim at diversified plans of action, and independent objects of investigation. While all have recorded the places of the bodies of the solar system, and have lent the assurance of number of observations, and consequent power of detection, to the *data* on which future planetary tables will be constructed, each one has tried, or is trying, to make the greatest progress of some one branch of astronomy peculiarly its own work. Thus, while Greenwich has constantly

devoted its peculiar attention, pursuant to the will of its founder, to the moon, the large equatoreal at Cambridge has suggested the researches of the Plumian Professor; the Radcliffe Observer at Oxford has devoted his special attention to the circumpolar stars, and will soon be furnished with a new mode of action by the possession of the splendid heliometer which is in preparation; and our lamented colleague at Edinburgh has left the materials for a catalogue of zodiacal stars. Differences of locality, of instruments, of mode of government, of taste and reading in the directors of different observatories, will originate differences of plan: it may be permitted to a body so closely connected with the common pursuit as your Council, and so deeply interested in the astronomical welfare of each and all of these institutions, to hope that these differences of plan will one day arise out of a matured system of co-operation, in which foreign observatories will be combined with our own. Much advantage has arisen in this country from the division of labour, which has thrown the observation of double stars and nebulæ upon the amateur astronomer; and more will always be gained, the larger the amount of strength and the wider the range of researches which are thus judiciously subdivided.

The benefit of co-operation has been lately seen in the junction of the observatories of Pulkowa, Altona, and Greenwich, for the determination of their differences of longitude. Our associate, Mr. Struve, had connected Pulkowa and Altona; and, having strongly represented to his government the propriety of taking Greenwich as the zero point for all longitudes, it was resolved to connect the two last-named observatories. A portable transit was erected during the last summer in a temporary observatory on the grounds of the Royal Observatory, and forty-two box chronometers were carried backwards and forwards by the steam-boats, eight times each way. At first Mr. Otto Struve observed at Greenwich, and Mr. Döllen at Altona, for two voyages: the observers were then reversed for four voyages, and again resumed their old stations for two more; by which arrangement it was hoped to eliminate both personal equation and its gradual changes. The clock in the temporary observatory was regularly compared with the Greenwich transit clock, so that the ordinary observations of the Observatory will contribute to the result: to this end all necessary observations for personal equation were made. The result is not yet completely calculated.

While the preceding operation was in progress, another of a similar kind was undertaken by the Astronomer Royal and Mr. Sheepshanks, for the connexion of Valentia in Ireland (the western point of Europe) and Greenwich; to which was added, the incidental determination of the longitude of Liverpool Observatory and Kingstown Harbour. Valentia is nearly in the latitude of Greenwich, and it will probably be the extremity of an arc of parallel extending across the south of Russia. Mr. Sheepshanks (and afterwards Mr. Hind) was stationed with a portable transit instrument at Kingstown, and thirty pocket chronometers were carried

backwards and forwards, eight times each way. The mode of carriage was as follows:—

The chronometers being in two well-padded cases, each containing fifteen, these cases were inserted in boxes which were screwed to the railway carriages and steam-boats (the owners of which gave every possible facility): these boxes were not disturbed throughout the whole operation, each one forming, in fact, a part of a carriage or steam-boat; all had similar locks, and each person employed was furnished with a key. An assistant took the chronometers from Greenwich to the Euston Square station; Mr. Hartnup received them at Liverpool and transferred them to the steam-boat; and Mr. Sheepshanks or Mr. Hind received them at Kingstown. In a similar manner, when a portable transit was erected at a station at Valentia, under the charge of Lieut. Gossett, R.E., the chronometers were carried backwards and forwards, ten times each way, in boxes fixed upon the mail coaches as far as Tralee, and afterwards in an express car, furnished by Mr. Bianconi.

Several parts of the disputed boundary between the United States and British North America are defined astronomically; and, to prepare for the proper execution of this part two officers of Engineers, Captain Robinson and Lieutenant Pipon, employed under the British Commissioner, Lieut.-Colonel Estcourt, were for some time stationed at the Royal Observatory. There was one point which was not necessarily astronomical, the drawing a straight line of between 60 and 70 miles to connect two defined points. As it appeared almost impossible to effect this by survey, from the difficult character of the country, Mr. Airy recommended that the azimuths at the two ends should be computed from observed latitudes and difference of longitudes, and that two parties should cut through the woods in the assigned directions, one from each terminal station. The two parties thus cutting, independently of each other, drew lines which met within 300 feet.

We have yet to acknowledge one more obligation to the Astronomer Royal, namely, the recent publication of a "Catalogue of the Places of 1439 Stars reduced to the 1st of January, 1840." This work contains the mean places of stars deduced from all the observations made at Greenwich in the years 1836 to 1841, inclusively. The place of the equinox is that resulting from observations during the same period. The year which corresponds to the mean of the observations of each element is also given; and the annual precession for 1840, with the proper motion for those stars in which account of proper motion has been taken. This necessary information with respect to the mean date was first given, we believe in the Cambridge Catalogue; and we trust that every future catalogue will also contain it. It is otherwise impossible to investigate proper motion, or the changes in proper motion, with the nicety which the present state of practical astronomy authorises us to apply to these delicate researches. The nomenclature is taken from Baily's *Flamsteed*, the magnitudes from Argelander's *Uranometria;* and there are columns of references for those stars which occur in

the Catalogues of Hevelius, Bradley, Mayer, Piazzi, the Astronomical Society, Groombridge, Pond, Argelander, Cambridge (first), Johnson, and Taylor. This brief notice needs no further comment here; for it would only be a waste of time to add one word describing the excellence of the instruments employed, the finish and perfection of the reductions, the care of the editor, or the utility of the final results. We congratulate all cultivators of astronomy on this noble addition to its *Fundamenta*, the influence of which will be instantly felt in every working observatory, and directly or indirectly throughout every department of the science.

In the Cambridge Observatory Professor Challis has confined himself in a great degree, so far as the meridian instruments are concerned, to the planets and those double stars which have been observed with the Northumberland equatoreal. A *first series* of observations of double stars is in preparation, and a *Second Cambridge Catalogue*, in continuation of the one which was inserted by Mr. Airy in our *Transactions*. The observations of the various recent comets with the equatoreal above mentioned will be valuable additions to the several yearly volumes.

Your Council have great satisfaction in directing the attention of the Society to the Observatory recently established at Liverpool by the corporation. In accordance with the advice of the Astronomer Royal, the astronomical portion consists of a transit-room and a dome for a large equatoreal. An adjoining apartment is appropriated to the chronometers which are brought there for trial or rating, and to the meteorological instruments; the rest of the building forms a comfortable house for the observer. A transit of five feet focal length and four inches aperture by Simms, a sidereal clock and a mean time clock by Molyneux, and a standard barometer (Newman's construction) by Adie of Liverpool, have been for some months in use, to the perfect satisfaction of Mr. Hartnup, the director. The telescope of the transit is a particularly fine one, and the mounting, which was directed by the Astronomer Royal, is the strongest and stiffest perhaps in existence. With the two clocks (which are within hearing of each other, and which are regularly compared whenever time is got or chronometer errors ascertained) it forms a perfectly efficient apparatus for getting and keeping the time, and is adequate to the most delicate determinations of right ascension. When the equatoreal is completed (the object-glass will have an aperture of eight inches, the mounting is to be under Mr. Airy's superintendence), we may expect most valuable assistance from the Liverpool Observatory in the extra-meridian branch of practical astronomy. But the principal and most interesting object of this establishment is, that of *giving true time to the great port of Liverpool*; an object which is of high national importance, and which has hitherto been almost unaccountably neglected. The observatory is admirably situated for this purpose, on the brink of the Mersey, at the entrance to the Waterloo Dock; the horizon is good, and infinitely better than could have been hoped for in the heart of a busy manufacturing

town. A ball similar to that at Greenwich is let fall every day, except Sunday, precisely at one P.M. Greenwich time, and the whole arrangement is so complete, and the longitude so well known, that the dropping of the balls at the two observatories may be considered to be simultaneous. It is evident that an observatory furnishing exact time will be of the greatest utility to all makers of *good* chronometers, and a hinderance to the venders of those which are indifferent. The ship-owners may, too, if they please, enjoy an advantage hitherto belonging solely to the Admiralty, that of having their chronometers tried and rated by a competent and disinterested party, previous to purchase; an advantage which will be thought almost inappreciable by persons fully aware of the dependence of modern navigation on the goodness of timekeepers; and, also, what indifferent watches are now disposed of to the unwary by ignorant and unscrupulous dealers. Mr. Hartnup's aid was most efficient in the measurement of the Valentia arc of longitude, and we trust that is only the first of many services to be rendered to science by this zealous and intelligent observer.

The magnificent telescope erected by the Earl of Rosse, which has attracted so much of public attention, is nearly in working order; nothing being now incomplete except some of the gallery machinery. It may reasonably be predicted that the energy which has called this instrument into existence will not quail before the more easy and pleasant task of using it. There is nothing on which it is so difficult to speculate as the probable results of an increase of optical power.

Passing to another extreme, your Council desire to notice the remarkable catalogue published by our associate, Mr. Argelander, of stars observed with the naked eye. The author is the Bayer of our generation, and his appreciation of magnitudes will probably come into universal use. He has reopened the road in which the astronomer may make himself useful without any instruments at all. His announcement of nearly thirty stars, which, though visible to the naked eye, are not to be found in any catalogue, startling as it may seem at first, will not, perhaps, surprise those who remember how various the objects of different catalogues have been. It is most desirable that these stars should be observed, with a view to the verification of the fact. If only half the number of new visible stars should be substantiated, it will be a useful lesson in any point of view. It is to be remembered that we are not positively to assume that these stars have been neglected by preceding observers: there is much reason to suppose that such bodies have before now disappeared. There may be *reappearances*, and there may be *new appearances*. Variable stars, with periods of several hundred years, or even less, might easily give rise to what Mr. Argelander has observed.

While commemorating the results of the past year, we ought not to forget those who are working in distant lands, under circumstances which prevent our receiving immediate information of their proceedings. Mr. Maclear's verification of Lacaille's arc at the

Cape of Good Hope is an operation in which English and French astronomers have each their peculiar interest; and some little account of this arduous and toilsome undertaking will doubtless be interesting to the Society.

With the aid of his assistants and a military detachment placed under his command, Mr. Maclear began, on the 1st of September, 1840, the measurement of a base line, eight miles in length, on the plains of Zwartland. Its direction is about west by south to east by north. The measurement of the first 1600 feet was repeated, and the difference of the results was found to be inappreciable, though the operation was rendered most harassing by the excessive heat. The measurement of the whole line occupied six months, not more than from 500 to 750 feet being completed in one day. Mr. Maclear thinks that there is just ground for believing that the entire base, 42,818 feet in length, is scarcely erroneous to the amount of half an inch, and that the error is probably much less than this.

Thenceforward the trigonometrical survey continued to occupy a large share of Mr. Maclear's attention. In December 1842 he proceeded in H.M.S. Arrow to take the zenith sector up to the Oliphant's River, which was then intended to be the northern limit of the arc, though it was afterwards deemed advisable to extend the triangulation both north and south of Lacaille's original arc; northward to Lily Fontein on the Kamies Berg, which has been accomplished; and southward to Cape l'Agulhas, which is approaching to completion.

This labour has subjected the observers to the greatest privations, to intense heat on the arid Karroos in summer, and to extreme cold in the winter, when they had to ascend such commanding heights as the Cedar Berg, the Snew Cop, the Winter Hock, and the Worcester Range, leaving their wagon or horses far below them, and being consequently reduced to sleep under the open sky, amidst snow and sleet, waiting from day to day, till the weather would admit of flashing their heliotropes towards the concerted points. Mr. Maclear speaks in the highest terms of the zeal of his assistants during the whole of these laborious and trying operations.

The East India Company has lately presented the Society with two valuable volumes, printed by the order of the Madras government. The first, containing the meteorological observations made at the Madras Observatory for twenty years (1822-1843), will find those who can more appropriately discuss its merits than your Council. The second touches us more nearly. It is a Catalogue of 11,015 stars, made from the five volumes of *Madras Observations*, and includes all of the Astronomical Society's Catalogue and of Piazzi's, which are visible at Madras, together with 3445 southern stars, selected with reference to the Paramatta Catalogue, all reduced to January 1, 1835, about the middle period of the observations. A systematic error of considerable magnitude in the divisions of the mural circle was discovered in 1840, and its amount ascertained

for each single division; and every place has been corrected for the error incident to the division in which it was observed. The proper motions of stars which appear to exceed a quarter of a second of space have been tabulated. Of the merits of this Catalogue it would be impossible to give any opinion at present; but your Council need not say that, from what is known of the zeal and industry of Mr. Taylor, they are well prepared to believe that it will soon be characterised as a valuable addition to sidereal astronomy, and an indispensable aid to the southern astronomer.

The progress of Sir John Herschel's reductions of his southern observations must interest the Fellows of this Society. From the state in which they now are, it is not very improbable that the Catalogue may appear in a year from this time. The constant attention which the completion of this great undertaking requires, has prevented Sir John Herschel from taking that share in the business of the Society, from which, previously to his departure for the Cape of Good Hope, its affairs derived so much benefit. The Council hope that the impediment will speedily cease to exist, not more for the sake of the Society than of its distinguished ex-president; for it must be admitted that, in travelling through the numerical reduction of observations, the astronomer finds very few of the flowers with which the love of science may strew the more intellectual part of the road.

By the death of Mr. Baily, the superintendence of the standard measure of length, and of the astronomical catalogues in progress at the expense of the government and of the British Association, pass into other hands. The standard scale has been undertaken by Mr. Sheepshanks, who has obtained from the Council the use of a vaulted room in the basement story in which to make the comparisons.

The *Nautical Almanac* for 1848, the fifteenth of the new series, appeared in the month of December last. For several years past, the advance which it was judged necessary to provide, namely, four complete years, has been gained; and it must not be forgotten that, when Lieut. Stratford was placed in charge of this national work, there was hardly a year in advance. On looking at the steady and effective manner in which this arduous undertaking has been executed, your Council feel that their praise is needless. With regard, however, to the obligations under which Mr. Stratford has laid astronomers, in matters unconnected with the immediate routine of the ephemeris, they can hardly be fully appreciated, and certainly not duly acknowledged, till after the next appearance of Halley's comet. There is also a stability given to the ordinary mode of conducting the *Nautical Almanac*, by the formation of a regular board of computers; a thing which did not exist when the present Superintendant came into office, and without which it would have been difficult to have fully carried out the recommendations of the *Nautical Almanac* Committee.

Since the last anniversary of the Society three comets have been discovered. The first was found by M. Mauvais at the Royal

Observatory of Paris on July 7; and, two nights afterwards, it was detected at Berlin. The elements differ materially from those of any comet whose orbit has been previously calculated.

The second comet was discovered at Rome at the observatory of the Collegio Romano, by our Associate, Signor Francesco de Vico, on the night of August 22. Considerable interest is attached to this comet, its period of revolution appearing to be only five and a half years. At the latter end of September it was easily seen with a small telescope; but, after that time, it became rapidly fainter, and, during the first week in December, was visible only with instruments of very great power. Another revolution of the comet will be completed in the early part of the year 1850.

A third comet was discovered on the evening of December 28, by M. D'arrest, of the University of Berlin. It is still visible. The elements somewhat resemble those of the second comet of 1793, for which Burckhardt computed an elliptical orbit of about twelve years' period; but the perihelion distance of the comet in 1793 was 1·4, while that of the present comet is only 0·9, a difference far too large to admit of the identity of the two bodies, except in the case of enormous perturbations.

Your Council will conclude this Report with one remark. It is obvious, from what has been stated, that this is a period of great activity, and that all parts of practical astronomy are in full cultivation. It may, perhaps, be rather a proof of this than the contrary, that the number of communications forwarded to the Society to be read at the ordinary meetings has materially decreased within the last few years. We may easily suppose that, as the work of the Observatory becomes more arduous, its superintendant has less time for the consideration of points which are not immediately connected with annual duties; and it is certain that nothing diminishes the occasional power of contributing to *Transactions* in the private astronomer, so much as self-devotion to some great branch of the subject, pointed out by personal taste or strong inducing circumstances. But, nevertheless, it ought to be remembered that the *Memoirs* of the Society are not merely the depository of facts, processes, or reasonings, which it is right to preserve. Though they may finally become nothing more, if it be right to apply such words to so important a function, yet it must be remembered that, on its first appearance, each volume is the impulse and stimulus of its day, the suggester as well as the receptacle of thought, the cause of future as well as the proof of past progress. The ordinary meetings of the Society must dwindle, to the serious diminution of its utility, unless they be nourished by communications of interest. And even granting that the magnitude of the objects on which astronomers are engaged at any one time, renders it almost impossible for them to supply the *Memoirs* at the equable rate hitherto maintained, it must not be forgotten that there are many points connected with the theory and practice, and, above all, with the history, of astronomy, which are constantly arising out of every research, directly or collaterally. Those to whom such things present themselves, are

especially requested by the Council to bear in mind that any interesting information, however inadequate to be the basis of a formal paper, finds its immediate use at our meetings, and its record in our *Monthly Notices*. There is much reason for regret in the circumstance that the scientific body of our day has almost entirely lost the character of the collector of suggestions worthy of consideration, hints of useful tendency, and valuable, but isolated, information. If the minutes of the Royal Society in the time which preceded the publication of the *Principia*, should now and then excite a smile, it will be checked by the obvious consideration that we owe much of what has been since done to the currency which the disposition to communicate, and the facilities for doing it, afforded to mere suggestions. Much might, perhaps, be done by encouraging the slighter and less elaborate form of communication, which it is one object of the *Monthly Notices* to perpetuate; and your Council hope that those Fellows who have shewn themselves capable of greater things, will not forget that the small matter which, thinking only of themselves, they might be inclined to throw on one side, may possibly meet the difficulty, or advance the object, of some other member of the Society. At the least, it will add attraction to the proceedings of the ordinary meeting, which it is so important to the welfare of the Society, and, through it, of astronomy, to render both instructive and interesting.

Titles of Papers read before the Society between February 1844 *and February* 1845.

1844.

March 8. Observations of the Comet of Faye. By W. Lassell, Esq.

Right Ascensions and North Polar Distances of the Comet of Faye, from Observations at the Royal Observatory, Greenwich. Communicated by G. B. Airy, Esq. Astronomer Royal.

Right Ascensions and Declinations of the Comet of Faye, observed with the Equatoreal at the Observatory of Trinity College, Dublin, by Mr. C. Thompson. Communicated by Sir W. Hamilton.

Observations of the Comet of Faye, by C. Rumker, Esq.

Observations of the Comet of Faye made at the Observatory, Durham. Communicated by the Rev. Temple Chevallier.

Observations made at Hartwell, by the Rev. J. B. Reade. Communicated by Dr. Lee.

Elements of the Comet of Faye. By Professor Henderson.

Elements of the Comet of Faye. By J. R. Hind, Esq.

Letter from Professor Encke, on the Comet of Pons.

Occultations of Fixed Stars by the Moon, observed at Hamburg. By C. Rumker, Esq.

Further Remarks on the Revision of the Southern Constellations. By Sir J. F. W. Herschel, Bart.

Extract from a Letter of Professor Bessel to Sir J. F. W. Herschel, Bart.

A Letter from J. R. Crowe, Esq. concerning a Society established at Alten. Communicated by Dr. Lee.

April 12. Additional Observations of Faye's Comet. Communicated by Sir. W. Hamilton.

Meridian Observations of the Moon and Moon-culminating Stars, made at Hamburg during the years 1838 and 1839. By C. Rumker, Esq.

Elements of the Comet of Mauvais. By M. Götze. Communicated by Dr. Lee.

Observations of the Comet of Encke made at the Cape of Good Hope. By T. Maclear, Esq.

An Account of the Erection of the Herschel Obelisk at the Cape of Good Hope, accompanied by Colonel Lewis's Report, and a Plan of the Obelisk. By T. Maclear, Esq.

On Loud Beats of Clocks used in Observatories. By J. S. Eiffe, Esq.

May 10. The Right Ascensions of the principal Fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope, in the years 1832 and 1833. By Professor Henderson.

Observations of the Great Comet of 1843, made at Cape Coast Castle by G. Maclean, Esq. Communicated by Capt. Beaufort.

Extract of a Letter from J. R. Crowe, Esq. to Dr. Lee. Communicated by Dr. Lee.

Elliptic Elements of Bremicker's Comet, by M. Götze. Communicated by Professor Schumacher.

Elements of the Comet of Faye. By J. R. Hind, Esq.

June 14. Some Remarks on the Telescopic Appearance of the Moon, accompanying a Model and a Drawing of a portion of her surface. By James Nasmyth, Esq.

Observations of the Solar Eclipse of 1843, made near Mahe. By John Caldecott, Esq.

Sextant Measures of the Sun at the Eclipse of the Sun, December 21, 1843. By Capt. Sir E. Belcher, R.N.

On a Graphical Method of Predicting Occultations. By J. I. Waterston, Esq. Communicated by Captain Beaufort.

Some Remarks on the Great Comet of 1843, as seen in the Neighbourhood of Paramatta. By the Rev. W. B. Clarke. Communicated by Sir John Herschel.

Observations made at the Hamburg Observatory. By C. Rumker, Esq.

Scheme of Planetary Elements. By S. M. Drach, Esq.

Nov. 8. Memoir of Francis Baily, Esq. By Sir J. F. W. Herschel, Bart.

Dec. 13. Observations of the Moon and Moon-culminating Stars,

made at Port Essington. By Owen Stanley, Esq. Commander, R.N.

Letter from M. Mauvais to Mr. Baily, announcing the discovery of a Comet.

Circular Letter from Professor Encke, announcing the independent discovery of the second Comet of Mauvais by M. D'arrest.

Astronomical Observations made at Hudson Observatory, United States, by E. Loomis, Esq. Communicated by Lieut.-Col. Sabine.

Elements and an Ephemeris of the second Comet of Mauvais. By Professor Henderson.

Observations of the second Comet of Mauvais. By W. Lassell, Esq.

Observations of the second Comet of Mauvais and of De Vico's Comet. By C. Rumker, Esq.

Observations of De Vico's Comet, made at Aylesbury, by T. Dell, Esq. Communicated by Dr. Lee.

Elliptical Elements of De Vico's Comet, with an Ephemeris. By J. R. Hind, Esq.

Observations of De Vico's Comet, made at Ashurst, by R. Snow, Esq.

Observations of the Great Comet of 1843, made at St. Helena, by G. Brand, Esq.

Extract from the Translation of a Letter from Professor Bessel on the Variability of the Proper Motions of *Sirius* and *Procyon*. Communicated by Sir John Herschel.

1845.
Jan. 10. On the Flexure of a uniform Bar supported by a number of equal Pressures applied at equi-distant points, and on the Positions proper for the Application of these Pressures, in order to prevent any sensible Alteration of the Length of the Bar by small Flexure. By G. B. Airy, Esq. Astronomer Royal.

An Account of some Ancient Astronomical Tables in the Library of the Rev. C. Turnor, A.M. F.R.S. &c. By Mr. R. Harris, Assistant Secretary to the Society.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

Hon. East India Company.
Royal Society of London.
L'Académie Royale des Sciences de l'Institut de France.
Depôt Général de la Marine de France.
British Association.
Royal Irish Academy.
Imperial Academy of St. Petersburg.

American Philosophical Society.
Royal Academy of Brussels.
Royal Academy of Berlin.
L'Administration Imperial des Mines de Russie.
La Société de Physique, &c. de Genève.
Royal Society of Edinburgh.
Royal Geographical Society.
Royal Asiatic Society.
Bombay Branch Royal Asiatic Society.
Geological Society of London.
Zoological Society of London.
Linnean Society of London.
Society of Arts.
The Observatory at Milan.
The Observatory at Bologna.
The Radcliffe Trustees.
The Master-General of the Ordnance.
The Registrar-General.
The Editor of the Athenæum Journal.

M. Aimé.
F. S. Archer, Esq.
Professor Argelander.
M. Biot.
Dr. P. A. Browne.
R. Bryson, Esq.
Professor Challis.
Professor Christie.
E. J. Dent, Esq.
M. C. Dien.
Professor Encke.
Dr. Flügel.
T. Forster, Esq.
Major J. D. Graham.
Count Graberg da Hemsö.
J. Herapath, Esq.
E. Hopkins, Esq.
T. Jones, Esq.
H. Lawson, Esq.
Professor Littrow.
Professor Mädler.
Professor Narrien.
J. Nasymth, Esq.
Professor Plantamour.
Rev. J. Pullen.
Professor Quetelet.
Rev. S. J. Rigaud.
C. Rumker, Esq.
W. Rutherford, Esq.
Lieut.-Col. Sabine.
Professor Schumacher.
Rev. R. Sheepshanks.
Capt. R. Shortrede.
F. W. Simms, Esq.
Mrs. Somerville.
C. Stokes, Esq.
Lieut. W. S. Stratford.
Professor Struve.
M. O. Struve.
R. Taylor, Esq.
M. Van Hulst.
J. Waterhouse, Esq.
Miss Wollaston.

The President (G. B. Airy, Esq. Astronomer Royal) then addressed the Meeting on the subject of the award of the Medal as follows:—

Before I proceed to my immediate object, you will allow me, gentlemen, to express my regret that the duty of addressing you should have fallen upon me. The place which I reluctantly oc-

cupy ought, in the ordinary course, to have been filled this day by one to whom this Society mainly owes its existence and prosperity, and with whose scientific life every portion of our history is indissolubly interwoven. I will not, however, enlarge further on this irretrievable loss, but will briefly remind you that every member of the Society, who has been proud of his connexion with it while its interests were successfully supported by Mr. Baily, is bound in honour and conscience to give his best efforts for its continued prosperity, by the means which have hitherto proved so successful: individual and independent efforts tempered by a love of unanimity, and zealous industry guided by prudent forethought.

It is the duty of your president, gentlemen, to announce the decision of the Council as to the award of the Medal which, by the laws of the Society, is at their disposal on the present occasion: and I have to inform you that the Council have awarded the Medal to Captain W. H. Smyth, R.N. Foreign Secretary of this Society, for his *Bedford Catalogue*, forming the second part of the work entitled *Celestial Cycle*, which has been published by that gentleman within a few months.

The *Bedford Catalogue* contains the most interesting double and multiple stars of which the primaries are in Piazzi's Catalogue, and a selection of clusters and nebulæ from Messier's Catalogue (*Conn. des Temps*, 1784) and from the papers of the two Herschels; comprising 170 nebulæ and clusters, 580 double stars, 20 binary systems, and 80 triple and multiple stars. The magnitude, colours, &c. of the stars are carefully noted; there are numerous comparisons with the results (published and unpublished) of other observers; and the proper motion of the primary of each system is given with care. This scientific information is accompanied with much antiquarian research and literary history, and the work is likely to prove extremely attractive to the general reader. But the value of the work, in reference to the Medal of this Society, is derived almost entirely from its measures of double and multiple stars, and to these I shall confine my further remarks.

The subject of the labours for which this Medal is awarded is interesting; and the circumstances under which the Medal is awarded are peculiar. It is incumbent on me to make a few remarks upon the subject, and to explain the circumstances to which I allude; but, after the Report which has so long engaged your attention, it is necessary for me to be brief.

The astronomy of double stars may be stated to have commenced with Mr. W. Herschel's paper in the *Philosophical Transactions*, 1782. It is, therefore, essentially a modern science. But it is worth while to remark that it was not then begun with the views which have since become the principal motives for pursuing it. It was begun with the intention of discovering whether the observations of stars presumed to be at very different distances, but nearly in the same position as seen from the earth, would exhibit any indication of the earth's annual parallax. No such indication was discovered; but an unexpected and perhaps a more important

result was in no long time deduced from the observations. The relative places of the components of a double star were found to change, and the change had no respect to the position of the earth in its orbit, but went on from year to year. In several instances the change altered its character so completely that it could be represented in no way but by supposing that one star revolves round the other. And from that time the observations have been pursued almost exclusively with the view of tracing the orbits of binary stars.

One step of great importance has been made. Methods have been successfully introduced for the investigation of the elements of the orbits of double stars, on the supposition that the law of gravitation applies to them. And these methods have been applied to many stars, and from the elements so computed ephemerides have been prepared, by means of which the theoretical position of the double stars, computed on the same law of gravitation, may be compared with the position which shall be observed in the heavens.

To complete this outline of the progress of double-star astronomy, it appears only necessary to add, that it is believed that not more than one or two stars have completed their revolutions since they were first observed, and that there is no sufficient evidence that the same orbit has been retraced in successive revolutions.

Had I attempted, gentlemen, to enter more in detail into the history of this science, I should have done little more than weary you with the repetition of the same name. A Herschel was the projector of the science; the same Herschel established it to the utmost extent to which a most powerful intellect using the most powerful instruments in the world could carry it; another Herschel improved the accuracy of the observations, increased their number, and fixed the positions of many stars for an epoch sufficiently distant from the former to give accurate measures of their motions; and, finally, introduced that method of determining the elements of their orbits which is yet probably the best that exists. A Struve has filled volumes with the records of the observations made with the magnificent instruments at his command. Compared with these, the additions made by others to the theory or to the observations appear small. Yet it would be unjust to omit mention of the labours of Savary on the theory, and of those of South, Dawes, Bessel, and Mädler on the observations. To these names we can now add that of one whose labours place him in a higher position, the name of Smyth.

I may perhaps, for a moment quit the scientific part of this notice to remark that this science is in its origin and principal advances essentially English, and that by far the greater part of the work done upon it has been done by private and not by official observers. The former class is one of whom our country has good reason to be proud. I say advisedly that, since the time of Tycho, no country has witnessed efforts, directed with such force, such judgment, and such perseverance, as those of Herschel and Groombridge in sidereal observation, and those of Baily in

astronomical literature and in observations of a different class. It has been the pride of our men of business to shew that in them at least the effect of the cares incidental to their position has been not to degrade but to sharpen the intellect; not to render it insensible to every thing but gain, but to shew that honourable gain is only a means to an end, and that that end is the very highest cultivation of the mind.

Although the instance before us is in some degree different, its general character is the same. An officer, whose rank has been derived, in the first instance, from the honourable profession of arms; whose European reputation has been founded upon his services, first as a volunteer and afterwards in official employment, in the scientific and useful task of maritime survey; employs the leisure hours of his riper years upon the furtherance of the astronomy of double stars, devotes to that object his fortune and his energies with a perseverance scarcely inferior to those of the persons to whom I have already alluded, and finally produces an extensive catalogue of double stars possessing, as we believe, the highest claims to the favourable reception of the scientific world. I cannot forbear to add that the results of this labour have been published in a form which cannot fail to fix the attention and to direct the studies of many other able men of the same class: but I add also that this circumstance ought to have no influence, and has had no influence, in deciding your Council on the award of this Medal.

I might offer you my reasons, gentlemen, for believing that observations, like those of double stars, requiring little calculation, but demanding peremptorily the most complete devotion of time and energies when favourable states of the air occur, are likely always to be better carried on by private observers than by official astronomers. I might state, that the regular observer, when wearied with five hours' calculation in the forenoon, is not likely to seize upon that precious sky which sometimes suddenly presents itself in the evening, and to continue his observations till dawning day terminates them. I might, on the other hand, explain that private observers can seldom undertake the masses of calculation which are incidental to meridional observations. But I shall remark no further on this than to observe that, in the instance of the double-star observations before us, as well as in many of the others, discretion has been shewn in the selection of the subject as well as perseverance and skill in the pursuit of it.

Gentlemen, the position of the person by whom this work has been executed is thus far important, that it is necessary for us to distinguish between the work executed in the discharge of official duty, and that which is presented by the gratuitous labour and expense of a private individual upon whom we have no claim of any kind. The former circumstance may frequently prevent us from even taking into consideration the merits of some important works: the latter will render similar works admissible for our judgment as to the propriety of awarding to them our medal. But

when I have said *admissible* for our judgment, I have said all. No claim whatever is established by this gratuitous character of the work. The claim must be founded only upon the value of the work with reference to the present wants of science: and to this point I shall now advert.

It has happened, gentlemen, that I have twice had the honour to deliver addresses from this chair, in which allusion has necessarily been made to the nature of the nebulæ, and of those apparently nebuloid bodies, the comets. I have endeavoured to explain my idea, that it is in the examination of these that the cosmogonic mysteries of the world are to be read on the large scale, as in geology on the small scale. The investigation of the motion of double stars appears to me likely to give us an insight into laws equally grand, but of very different character. It is here alone that we can see the mechanics of the universe on a grand scale. The radius of the orbit of *Uranus* is small in comparison with the distance of the two stars of 61 *Cygni*, and probably *very* small in comparison with the distance between the components of some binary stars whose parallaxes have not yet been ascertained. The law of gravitation seems to be failing even at the distance of *Uranus*. May it not, perhaps, fail more completely, or may not a different law almost completely prevail over it, at distances like those of the double stars? Whether this question is to be answered affirmatively or negatively, and whatever may be the modification which the law may require, this appears certain, that it is only in the observation of double stars that we can find an answer to the question.

If now we inquire what is the quality of our observations upon which the correctness of our answer will mainly depend, we find that it is *accuracy;* comprising under this word the two different steps, of exactness in making observations, and certainty in transmitting them to the reader. And upon the importance of this accuracy, as contrasted with number or variety, I cannot express my opinion with sufficient strength. It is matter of history that the establishment of the laws of Kepler, of the system of Copernicus, and finally, of the theory of gravitation, depended upon a discordance between the theory of that period and the observations amounting to eight minutes of arc. This was then a small quantity but certainly appreciable, if the best instruments and best methods of the time were used. Now, gentlemen, am I wrong in saying that the establishment of a cosmical theory, infinitely more comprehensive and more important than that of gravitation, may depend upon the certainty of a measure to the tenth part of a second? I say, that it is more than possible; that it is highly probable; and that there is fair probability of its occurring within our time. Kepler on a similar occasion put to himself the question, "Is it likely that an observer so accurate as Tycho can have been in error by eight minutes?" and boldly answered to himself, "It is impossible, and, therefore, a new theory must be formed." When the question shall be put regarding the measures of the Bedford

Catalogue, made at a critical time, and on which a future theory may hinge, Can these numbers be trusted with certainty to one or two-tenths of a second? shall we be able to answer, Without doubt they can? This leads me to a very important part of my present remarks.

The Catalogue of the Celestial Cycle, as exhibited to the public, contains simply the result for each star of all the observations made on that star. In some cases results are given for more than one epoch: but, in all cases, every result is given without exhibition of the individual observations from which it was deduced. This form of publication is open to a very grave objection, and one which was seriously discussed by your Council. In a remark above I spoke of the accuracy of published observations as depending on two circumstances: exactness in making the observations, and certainty in transmitting them to the reader. With regard to the exactness of the observations, we had the evidence of a member of the Council who had compared unpublished observations made under the most unquestionably favourable circumstances with individual observations made by Captain Smyth: and we had also the indirect evidence derived from the progressive changes in the relative positions of some of the stars. These kinds of evidence probably had their weight with members of the Council; but to me, I must aver, they were entirely unnecessary. My confidence in the exactness of the observations is purely personal. Knowing the attention which has been given to the adjustments, the intentness of the observer upon his work, the nerve which is made steady rather than disturbed by the anxiety to procure a good observation, and the general skill in the management of the instruments, I can truly say, that if an accurate observation were required, I would desire that it should be made by Captain Smyth. Yet I could wish that I had the means of exhibiting to the world the grounds of my general confidence in the skill of the observer. Still more, I wish that I could produce sufficient means for estimating numerically the probable error of the observations, as affected not only by personal sources of error, but also by the causes of error which no skill can overcome. These remarks apply to the probable exactness of the observation only. With regard to the certainty of transmission to the reader, there is no sufficient security. The fairness of apportionment of weights, the correctness of means of separate results, the correctness of the printing; for all these there is no security. Let it not be supposed that these remarks are answered by referring me to the circumstances, that the computation is easy, that it has been performed by the astronomer himself or immediately under his eye, and that he has himself superintended the printing. I know by experience that errors are more likely to occur in easy than in difficult computation: that the principal person usually performs calculations and reads proof sheets with less accuracy than comparatively illiterate assistants; and that, after all his care in passing the sheets through the press, errors will creep in over which he has no control whatever. Had the manuscripts of the

observations and of the calculations in this instance been placed at our command, my remarks would have been completely answered. In the case of Lord Wrottesley's Catalogue, to which the Medal of this Society was awarded, and in that of Groombridge's Catalogue, the printing of which was placed by the Admiralty under my superintendance, the original observations and the intermediate calculations were placed at the command of this Society; and the repeated references which already it has been found necessary to make to the latter manuscripts prove the propriety of this caution. In the instance of the Bedford Catalogue we have no such power of referring to the originals. Feeling these things, gentlemen, and impressed with a sense of the responsibility to you and to the world of science which is implied by my position in this chair, I deem it my duty to state to you, that I for one have hesitated in assenting to this award except in the hope that the manuscripts relating to these observations would at some time be placed in our hands. And I am fully persuaded that it is the general feeling of the Council that the reasons upon which this Medal is now presented are such as have never before been used to justify our awards, and are not likely to be used again. I trust that the value of the Medal will be greatly enhanced to Captain Smyth by this consideration. I trust that he will perceive that, where direct evidence was wanting, this Council have not refused to give to the world their most solemn assurance of the value of the Bedford Catalogue, relying only, until further security shall be given to them, upon their personal appreciation of the instrumental skill, the editorial care, and the general exactness and fidelity of the observer.

(*The President then, delivering the Medal to Captain Smyth, addressed him in the following terms*):—

Captain Smyth,—In the name of the Council of the Royal Astronomical Society, I present to you this Medal. And I beg leave to convey with it the expression of my own opinion that never was a Medal more worthily earned. Permit me, sir, at the same time to remark, that the character of the Council is most deeply pledged in this award, and that I trust that, at no distant period, it will be redeemed by such communication of the details of the observations as will enable the Council to refer other inquirers to publications that are within the reach of all for a sufficient justification of this judgment.

The Meeting then proceeded to the Election of the Council for the ensuing Year, when the following Fellows were elected, viz.

President: Captain W. H. Smyth, R.N. K.S.F. D.C.L. F.R.S. —*Vice-Presidents:* George Biddell Airy, Esq. M.A. F.R.S. Astronomer Royal; Samuel H. Christie, Esq. M.A. F.R.S.; Bryan Donkin, Esq. F.R.S.; Thomas Galloway, Esq. M.A. F.R.S.—

Treasurer: George Bishop, Esq.: — *Secretaries:* Rev. Robert Main, M.A.; William Rutherford, Esq. — *Foreign Secretary:* Rev. Richard Sheepshanks, M.A. F.R.S.—*Council:* George Dollond, Esq. F.R.S.; Solomon M. Drach, Esq.; Lieut.-Col. George Everest, F.R.S.; Rev. George Fisher, M.A. F.R.S.; Manuel J. Johnson, Esq. M.A.; John Lee, Esq. LL.D. F.R.S.; Edward Riddle, Esq.; Richard W. Rothman, Esq.; Lieut. William S. Stratford, R.N. F.R.S.; The Right Hon. Lord Wrottesley, M.A. F.R.S.

James Joseph Sylvester, Esq. F.R.S.; John Glaisher, Esq. of the Observatory at Stone, near Aylesbury; William Dashwood Fane, Esq. of Old Square, Lincoln's Inn; John Hartnup, Esq. Director of the Observatory at Liverpool; and the Rev. William Reade, B.A. of Welby, near Grantham, were balloted for, and duly elected, Fellows of the Society.

The following communication, which contains a continuation of the observations of Mauvais' second Comet made at the Cape of Good Hope, has been received since the Meeting:—

Observations of Mauvais' second Comet made at the Royal Observatory, Cape of Good Hope, under the direction of T. Maclear, Esq. Communicated by the Astronomer Royal.

Day of Observation.	Star of Comparison.	Cape Mean Time for R.A.	Difference of Right Ascension.	No. of Obs.	Cape Mean Time for Declination.	Difference of Declination.	No. of Obs.
1844.		h m s	m s		h m s	′ ″	
Nov. 10	(12)	14 59 4·5	−0 56·22	10	14 59 4·5	+17 52·2	10
	(12)	15 45 49·6	−0 59·90	12	15 45 49·6	+19 22·6	12
11	(13)	14 49 40·6	+1 12·60	8	14 49 40·6	− 5 24·1	8
15	(14)	14 58 57·4	+1 44·22	10	14 58 57·4	+29 20·3	10
	(14)	15 48 30·3	+1 39·44	8	15 48 30·3	+31 9·3	8
16	(15)	14 45 39·1	+2 59·71	6	14 45 39·1	+12 47·4	6
	(15)	15 32 45·7	+2 54·98	9	15 32 45·7	+14 32·1	9
19	(16)	14 11 56·1	+0 13·53	10	14 11 56·1	− 1 6·7	10
	(17)	15 9 33·7	−3 2·30	12	15 10 55·0	−23 51·3	11
21	(18)	14 33 32·6	−3 31·58	10	14 33 32·6	+18 21·6	10
	(18)	15 38 36·8	−3 40·87	10	15 38 36·8	+21 14·3	10
24	(19)	14 52 58·3	+0 53·79	12	14 52 58·3	+12 38·0	12
25	(20)	14 33 58·9	−1 16·61	5	14 33 58·9	−20 7·9	5
	(20)	15 5 12·6	−1 21·31	6	15 5 12·6	−18 41·8	6
	(20)	15 36 19·5	−1 26·64	6	15 36 19·5	−17 17·2	6
26	(21)	15 15 56·3	−1 3·29	9	15 15 56·3	−13 38·8	9
	(22)	15 52 53·3	+2 17·43	5	15 52 53·3	+ 7 21·9	5

The sign + denotes the comet's right ascension or declination to be greater than the star's; the sign — the contrary.

The observations were made with Dollond's 46-in. achromatic telescope and position-wire micrometer having two moveable wires (spider lines), and one fixed at right angles to them.

The preceding observations are not corrected for the effects of refraction and parallax.

Approximate Places of the Stars of Comparison.

Star.	Mag.	Approximate Right Ascension.	Approximate Declination.	Remarks.
		h m s	° ′	
(13)	8·9	12 14 35	−33 8	
(14)	7·8	12 5 47	35 52	
(15)	7	12 2 37	37 0	
(16)	9	11 57 43	39 57	
(17)	6	12 0 54	40 22	No. 6471 of the Madras General Catalogue.
(18)	6	11 55 39	41 34	No. 6430 of the Madras General Catalogue.
(19)	8	11 40 56	44 43·5	
(20)	8·9	11 39 19	46 18	
(21)	7·8	11 34 44	47 18·8	
(22)	6·7	11 31 17	−46 59·6	

Note.—In the former list of observations the differences of declination made on November 10 were not corrected for the index error of the micrometer. The observations are repeated above, with the proper correction.

London :—Printed by Moyes and Barclay, Castle Street, Leicester Square.